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DESIGN PROCEDURE FOR EQUIRIPPLE NONRECURSIVE DIGITAL FILTERS

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Abstract

A design procedure for the class of nonrecursive digital filters exhibiting equiripple passband and stopband characteristics is presented. With this method it is possible for a designer to obtain the coefficients necessary to realize a desired filter without having to implement the design algorithm on a general-purpose digital computer. This method also enables the designer to examine several alternative designs before deciding on a particular solution. In particular, using a recently proposed algorithm, we have generated designs for more than 500 filters and systematically catalogued them in both tabular and graphical form. Design curves relating the various filter parameters are presented, as are relations for estimating the required filter specifications and for interpolation on the curves between tabulated designs. Transformations are included to cover highpass filter design and to enable the design of other sets of filters not explicitly catalogued. Sections are included to demonstrate the use of the design curves and tables and to discuss nonlinear phase filters. An appendix by Joseph Siegel gives the computer program used to generate the design solutions.

TABLE OF CONTENTS

I.	INTRODUCTION	1
II.	EQUIRIPPLE APPROXIMATION TO IDEAL LOWPASS DESIGN	5
III.	LAGRANGE INTERPOLATION DESIGN ALGORITHM	8
IV.	FILTER SPECIFICATION AND RANGE OF PARAMETERS	11
V.	LAYOUT OF DESIGN TABLES AND DESIGN CURVES	13
VI.	FORMULAS FOR ESTIMATING DESIGN PARAMETERS	16
VII.	USE OF DESIGN CURVES AND TABLES	17
	7.1 Lowpass-Filter Design	17
	7.2 Design of Filters Derivable from Listings	19
	7.3 Highpass-Filter Design	22
	7.4 Nonlinear-Phase Filter Design	26
	7.5 Interpolation on the Design Curves	26
VIII.	CONCLUSION	28
Appendix A	Design Tables	30
Appendix B	Design Curves	42
Appendix C	Unit Sample Response Listing	84
Appendix D	Design Program	132
Acknowledgment		144
References		145

I. INTRODUCTION

Nonrecursive digital filters have traditionally enjoyed advantages not obtainable by recursive realizations. These filters can be designed to approximate a given magnitude frequency response to a desired accuracy and also to have an exactly linear phase. This last property follows directly from the fact that nonrecursive digital filters have a unit sample response of finite duration. Consequently, a zero-phase filter can first be designed by prescribing the unit sample response to be a real and even function. Then by cascading this filter with a finite delay equal to the negative time portion of the filter unit sample response, a realizable system can be obtained. Since the effect of this finite delay is to introduce a linear phase term into the frequency response, the resulting system is a realizable, nonrecursive digital filter exhibiting an exactly linear phase characteristic. Additionally, since the transfer function of a nonrecursive digital filter has no poles in the finite z plane, instability resulting from coefficient inaccuracy is not a problem, as it is in recursive filter design.

Until recently, nonrecursive digital filters were most commonly realized by direct convolution, a process which becomes increasingly impractical as the filter order is allowed to increase. This disadvantage no longer holds when we apply the Fast Fourier Transform (FFT) algorithm to implementation of high-order filters and adapt powerful optimization techniques to the approximation problem. Now it is practical to design filters of arbitrary order. The net result of these developments has been a renewed interest in the design of frequency selective, nonrecursive digital filters.

The approximation problem in the design of nonrecursive digital filters basically involves obtaining a suitable approximation to a generally specified or ideal frequency response. As distinguished from the recursive case, in which the realizable approximations can be expressed as a ratio of two trigonometric polynomials and the extensive results of analog filter theory can be applied via the bilinear transformation, the realizable nonrecursive approximations are constrained to be trigonometric polynomials and the bilinear transformation is not applicable. At present, there are several methods for approximating a desired frequency response with a nonrecursive digital filter. A few of these methods will be briefly discussed.

1.1 WINDOWING

Perhaps the most widely used technique for approximating a specified frequency characteristic has been to approximate the infinite duration unit sample response of an ideal filter with the finite-duration unit sample response of a nonrecursive realization. Since direct truncation of the ideal filter unit sample response results in the Gibbs phenomenon, a fixed percentage overshoot and ripple in the vicinity of a discontinuity, it is necessary in practice to modify this unit sample response by multiplication with a time-limited window or weighting function. The effect of this multiplication in the time domain is a complex convolution in the frequency domain which smooths the spectrum of the filter. Appropriate choice of the window function leads to frequency characteristics with appreciably less in-band and out-of-band ripple, and acceptable filter designs. The criterion requiring the weighting function to have a transform with a narrow main lobe of high-energy content and small sidelobes with significantly less energy content has resulted in many useful designs which have been summarized by Rabiner,[1] Kaiser,[2] and Helms.[3]

1.2 FREQUENCY SAMPLING

Rabiner, Gold, and McGonegal[4] have developed another technique, originally proposed by Gold and Jordan,[5] for the design of nonrecursive digital filters. This method involves an initial specification of the desired frequency response at a certain number of uniformly spaced frequency samples. The number of these samples is taken to be the duration of the filter unit sample response, and the frequency samples are designated as the discrete Fourier transform of this unit sample response. As a result, the continuous frequency response is linearly related to the specified frequency samples and is exactly determined as an interpolation between them.

Sampling of the frequency response of an ideal filter generally results in aliasing of the unit sample response and in overshoot and rippling of the frequency characteristics between sample points. In order to improve the frequency response at intersample frequencies, a number of frequency samples at the band edges are varied in magnitude so as to increase the transition bandwidth and reduce the ripple variations. Then, using a linear search and optimization algorithm, the values of these transition-band frequency samples are varied to minimize the maximum deviation between the desired and designed filter characteristics over some prescribed frequency range. Increasing the number of samples in the transition band provides for even better ripple cancellation. Practical considerations, however, limit the number of unconstrained variables that can be varied simultaneously, and hence limit the degree to which the ripple can be suppressed.

1.3 NONLINEAR OPTIMIZATION

Herrmann and Schuessler[6,7] have developed a third technique for the design of nonrecursive digital filters. This technique can be used to design filters with equiripple passband and stopband characteristics. The maximum allowable ripple values for both the passband and stopband are prescribed independently, as are the number of passband ripples N_p, and the number of stopband ripples N_s. With $N = N_s + N_p - 1$, a set of 2N nonlinear equations are then prescribed to constrain the frequency characteristic of the filter to the desired tolerance scheme. These equations force an N^{th} order polynomial to have extrema that achieve the maximum allowable ripple values and to have zero slope at the frequencies where the extrema occur. The equations are then iteratively solved by means of a nonlinear optimization technique to yield the N-1 unknown interior extremum frequencies and the N+1 unknown filter coefficients. This procedure yields good results for filters of moderate order, but as the number of unknowns becomes large available algorithms fail to converge; the suitability of this method is therefore restricted.

1.4 LAGRANGE INTERPOLATION

The windowing and frequency sampling techniques do not generally yield filters with equiripple characteristics. Hence they are suboptimal in the sense that they do not yield filter characteristics with the smallest possible transition bandwidth for fixed passband and stopband tolerances. It is possible to modify the method presented by Rabiner et al.[4] to yield equiripple designs, but more work is necessary before an objective evaluation of the procedure can be made. On the other hand, the approach taken by Herrmann and Schuessler[6,7] does yield equiripple characteristics, but is restricted to the design of filters of relatively modest order.

A new technique presented by Hofstetter, Oppenheim, and Siegel[8,9] appears to avoid the computational difficulties encountered with the nonlinear optimization technique and still provides an equiripple design. Following the terminology first adopted by Herrmann and Schuessler, the design approximation for a lowpass filter is specified in terms of δ_p, the maximum allowable deviation in the passband; δ_s, the maximum allowable deviation in the stopband; N_p, the maximum number of passband ripples; and N_s, the maximum number of stopband ripples. Use of the design algorithm results in a filter with the maximum number of passband and stopband ripples and the minimum duration unit sample response of 2N+1 samples, where $N = N_p + N_s - 1$, and the ripple specifications have included extrema located at frequencies of zero and π radians. A more detailed explanation of the design algorithm is presented in Section III. For now it can be described as an iterative procedure which, through the use of the Lagrange interpolation formula, evolves from an initial estimate of the set of extremum frequencies to the desired continuous frequency response.

It can be shown[8] that of all filters satisfying the type of tolerance scheme mentioned above the subset with the narrowest transition bandwidth occurs when the frequency characteristics are specified to be equiripple. It can also be shown that there exists a unique set of filter coefficients yielding this equiripple behavior when the frequency response is real. Since the Lagrange interpolation method is optimal, in that it provides for equiripple designs, and since it can be used to design filters of arbitrarily large order, it is the method that will be considered throughout the rest of this report.

The Lagrange method, like the other iterative techniques, has one drawback. Because of its iterative nature the design algorithm must be implemented on some type of general-purpose digital computer. As a result, a filter designer wishing to use any of the iterative or optimization techniques discussed here would first have to program the design algorithm or adapt an existing algorithm to his particular needs. Then he would still have to expend a significant amount of computer time to generate one particular solution, and if he needed to compare several alternative designs, he would have to generate individual solutions for each. It is apparent that such a procedure could become both costly and time-consuming and that an alternative method is required.

The method proposed here is to provide the filter designer with a comprehensive set of design curves and tables that will facilitate the design and implementation of the class of equiripple nonrecursive digital filters discussed by Hofstetter et al.[8] Designs are catalogued both in tabular and graphical form for many standard filters used in practice. Confronted with the design problem for a generally specified filter characteristic, the designer may survey the design curves for the solution to his particular problem. If the filter in question is one of the many explicitly catalogued, the designer need only retrieve the filter coefficients from the tabular data. If the particular filter has not been explicitly catalogued the curves and tables may be used to compare catalogued designs and make reasonable trade-offs to arrive at a compromise solution. Finally, if none of the catalogued designs are acceptable, the designer may use the design curves and the general specifications of his filter to obtain the design parameters necessary for an exact computer solution of his problem.

The Lagrange interpolation method is applicable to the design of generally specified frequency characteristics including conventional lowpass, highpass, bandpass, and bandstop filters, as well as to the design of piecewise-constant and some nonpiecewise-constant frequency characteristics. Throughout this report the discussion is generally phrased in terms of nonrecursive lowpass digital filters with equiripple band characteristics and linear phase. Sections are included, however, to cover transformations from the lowpass designs to other types of filters such as highpass designs, and to discuss filters with nonlinear phase characteristics.

II. EQUIRIPPLE APPROXIMATION TO IDEAL LOWPASS DESIGN

The frequency response of an ideal lowpass filter is unity in the passband and zero in the stopband. Because of the sharp step discontinuity and zero transition bandwidth implied by this characteristic, the ideal filter (shown in Fig. 1) cannot be realized exactly in practice. Instead, the equiripple approximation (Fig. 2) which provides for an allowed deviation about one in the passband and about zero in the stopband as well as for a nonzero transition band, will be realized via a nonrecursive digital filter with linear phase. The following notation, illustrated in Fig. 2, is used throughout this report.

Symbol	Definition
$H(z)$	Transfer function of the linear-phase filter
$H_o(z)$	Transfer function of the zero-phase filter
F	Normalized frequency = fT
f	Analog frequency
T	Sampling interval
δ_p	Maximum allowable deviation about one in the passband
δ_s	Maximum allowable deviation about zero in the stopband
N_p	Maximum number of passband ripples (including one at $F = 0$)
N_s	Maximum number of stopband ripples (including one at $F = 0.5$)
$N = N_p + N_s - 1$	Order of the Lagrange interpolation polynomial
F_p	Passband cutoff frequency, at which the frequency characteristic first leaves the passband
F_s	Stopband cutoff frequency, at which the frequency characteristic enters and remains in the stopband
F_k; $k = 1, \ldots, N+1$	Extrema frequencies at which ripples achieve their allowed maximum values
$TBW = \lvert F_s - F_p \rvert$	Width of the transition band between passband and stopband

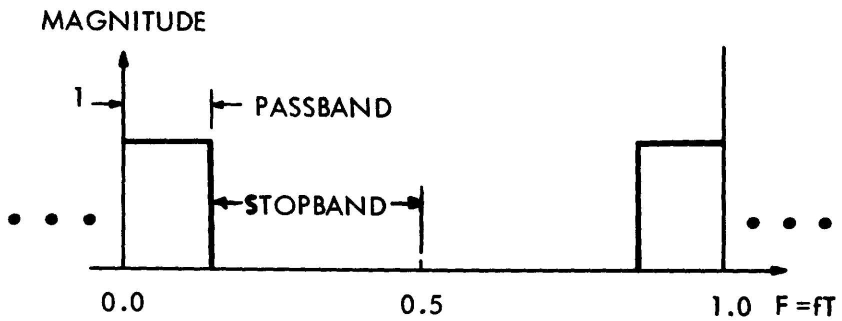


Fig. 1. Ideal lowpass filter frequency response.

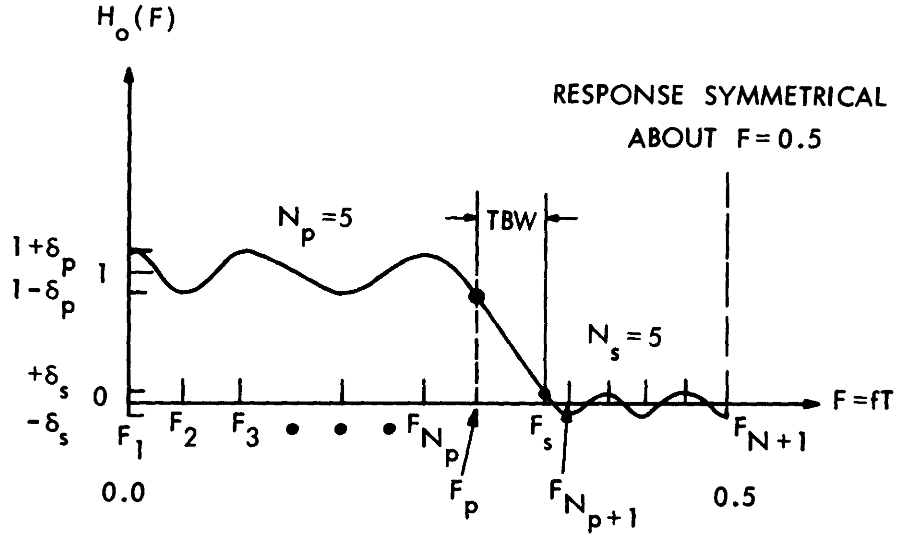


Fig. 2. Equiripple approximation to ideal lowpass design.

In these terms linear phase, equiripple, nonrecursive digital filters can be described by a transfer function of the form

$$H(z) = \frac{1}{z^{2N}} \sum_{k=0}^{N} a_k \frac{(z^{N+k}+z^{N-k})}{2}. \tag{1}$$

Evaluating the complex variable z at $z = \exp(j2\pi F)$ yields the frequency response

$$H(z)\Big|_{z=e^{j2\pi F}} = H(e^{j2\pi F}) = \exp(-j2\pi FN) \sum_{k=0}^{N} a_k \cos 2\pi Fk, \tag{2}$$

which can be put in the form

$$H(e^{j2\pi F}) = \exp(-j2\pi FN)\, H_o(F). \tag{3}$$

With the filter coefficients constrained to be real, the frequency response is composed of a linear-phase term $\exp(-j2\pi FN)$ and the purely real frequency response $H_o(F)$ of a zero-phase filter. Since the linear-phase term only introduces a finite delay of N samples into the filter unit sample response, the design problem becomes one of fitting $H_o(F)$, a mirror-image polynomial, to the tolerance scheme prescribed in Fig. 2. Since $H_o(F)$ is a real mirror-image polynomial, its zeros must occur in complex conjugate reciprocal pairs on or about the unit circle. (This and other properties of mirror-image polynomials are presented elsewhere.[10]) Using Eqs. 2 and 3 it can be seen that

$$H_o(F) = \sum_{k=0}^{N} a_k \cos 2\pi Fk, \tag{4}$$

which can also be put in the form

$$H_o(F) = \sum_{k=0}^{N} c_k(\cos 2\pi F)^k = \sum_{k=0}^{N} c_k x^k, \tag{5}$$

where $x = \cos 2\pi F$. As a result, the approximation problem reduces to one of approximating a generally prescribed lowpass frequency characteristic with a trigonometric polynomial.

III. LAGRANGE INTERPOLATION DESIGN ALGORITHM

The technique used to achieve this trigonometric polynomial approximation to an ideal lowpass design was proposed by Hofstetter, Oppenheim, and Siegel.[8, 9] Given desired values for N, N_p, δ_p, and δ_s, the design algorithm first estimates an initial set of extremum frequencies $F_k^{(0)}$; k = 1, 2, ..., N+1 at which the extrema of the desired frequency response $H_o(F)$ are to be located. It then uses the barycentric form of the Lagrange interpolation formula to obtain an N^{th}-order polynomial that passes through the maximum ripple values ($1\pm\delta_p$ in the passband and $\pm\delta_s$ in the stopband) at these prescribed frequencies. In general, this first Lagrange polynomial will achieve its extrema at frequencies distinct from the estimated set of original frequencies $F_k^{(0)}$ and additional stages of the algorithm will be required. The second stage of the algorithm locates the frequencies associated with the extrema of the first Lagrange polynomial and uses these new frequencies $F_k^{(1)}$; k = 1, 2, ..., N+1 as a revised estimate of the set of extremum frequencies at which the desired frequency response is to achieve its maximum ripple values. The cycle is completed when a second Lagrange interpolation polynomial is constructed so as to pass through the specified ripple values at this second set of estimated extremum frequencies. At this point the extremum frequencies $F_k^{(2)}$; k = 1, 2, ..., N+1 of this second Lagrange polynomial can be located, and if different from the $F_k^{(1)}$ the algorithm can proceed iteratively to the desired solution.

In practice, the iterations were terminated and the algorithm was determined to have reached a solution when all of the extremum frequencies $F_k^{(\ell)}$; k = 1, 2, ..., N+1 at the last iteration were equal to the corresponding set of frequencies $F_k^{(\ell-1)}$; k = 1, 2, ..., N+1 used in the previous iteration. A formal mathematical proof of convergence is not available, but in our set of reference designs compiled for more than 500 filters covering a wide range of specified tolerances and including filter responses as long as 255 samples, we have found that the algorithm converged quite rapidly to the desired solution in every case.

All of the design solutions tabulated in Appendix A were generated on an IBM 360 computer using a version of the Lagrange interpolation algorithm programmed by Joseph Siegel (Appendix D). Only minor modifications of the program were made to increase its efficiency in the design of large sets of filters and to insure convergence for a few anomalous cases.

Direct use of the design algorithm yields a set of coefficients and a set of extremum frequencies F_k; k = 1, 2, ..., N+1 that completely define the continuous frequency response $H_o(F)$ of the desired filter through the Lagrange interpolation formula. Important as these quantities may be, they are not of much practical use to the filter designer who wants to implement a particular design. For this reason, the filter unit sample response $h_o(n)$; n = −N, −N+1, ..., 0, ..., N−1, N is included as part of the specifications for each tabulated design.

The actual filter coefficients, the a_k of Eq. 4, are easily related to the filter unit sample response, as we see by noting that if $h_o(n)$ represents the unit sample response of the specified zero-phase filter, then the frequency response can be written

$$H_o(F) = \sum_{k=-N}^{N} h_o(k)\, e^{-j2\pi Fk}. \tag{6}$$

Note that the summation index ranges only over a set of 2N+1 values, since $h_o(k)$ is identically zero for $|k| > N$. Equation 6 can be rewritten

$$H_o(F) = h_o(0) + \sum_{k=1}^{N} h_o(k)\, e^{-j2\pi Fk} + \sum_{k=-1}^{-N} h_o(k)\, e^{-j2\pi Fk}. \tag{7}$$

Since $h_o(n)$ was specified to be a real and even function,

$$H_o(F) = h_o(0) + \sum_{k=1}^{N} h_o(k)(e^{j2\pi Fk} + e^{-j2\pi Fk}), \tag{8}$$

and finally

$$H_o(F) = h_o(0) + \sum_{k=1}^{N} 2h_o(k) \cos 2\pi Fk. \tag{9}$$

We see that Eqs. 9 and 4 are exactly of the same form, and that the filter coefficients are related to the filter's unit sample response by the equations

$$a_o = h_o(0)$$

and (10)

$$a_k = 2h_o(k); \qquad k = 1, 2, \dots, N.$$

More generally, it is known that the unit sample response of a nonrecursive digital filter with duration M samples is related to the M point sequence

$$H(e^{j2\pi F})\Big|_{F=n/M}; \qquad n = 0, 1, \dots, M-1$$

formed by sampling the continuous frequency response at a set of M equally spaced points on the unit circle. In particular, the inverse discrete Fourier transform relation reveals that the filter unit sample response can be obtained from the calculation

$$h(n) = \frac{1}{M} \sum_{k=0}^{M-1} H(e^{j(2\pi k)/M})\, e^{+j(2\pi kn)/M} \qquad n = 0, 1, 2, \dots, M-1. \tag{11}$$

This method was modified to take advantage of the symmetries inherent in the filter specifications, and the unit sample response for each of the tabulated filters was calculated in double-precision arithmetic by a subprogram incorporated in the main design program. Perhaps it would have been more efficient to evaluate the inverse discrete Fourier transform by means of the fast Fourier transform (FFT) algorithm, but for most of the catalogued filters the saving in computer time would have been insignificant. The subprogram DFT (discrete Fourier transform) essentially requires N^2 arithmetic operations to specify a unit sample response, while the FFT requires approximately $M \log_2 M$ operations, where M is the next largest power of 2 above 2N+1. Considering $M = 2N$ and $N = 128$, we find in this case that the DFT requires approximately 16,000 operations and the FFT approximately 2000. With each operation performed in $\cong 10^{-5}$ s, use of the FFT would result in a saving of ~0.14 s. Also, since the most readily available form of the FFT was implemented only in single-precision arithmetic, we decided to use the subprogram DFT.

Although all of the designs that are catalogued are of the lowpass variety, the algorithm as programmed is capable of designing bandpass as well as lowpass filters and, through simple transformations, is also applicable to bandstop and highpass filter design. Furthermore, as explained elsewhere,[8] the Lagrange interpolation method is amenable to the design of filters with more generally specified frequency characteristics, including lowpass and frequency-selective differentiators, as well as filters with piecewise-constant characteristics.

IV. FILTER SPECIFICATION AND RANGE OF PARAMETERS

Use of the Lagrange interpolation design algorithm requires the initial specification of the parameters δ_p and δ_s, as well as any two of the three parameters N, N_p, or N_s. The resulting design has a frequency characteristic with N_p passband ripples, each achieving a maximum value of $1 \pm \delta_p$, N_s stopband ripples of maximum height $\pm\delta_s$, and certain cutoff frequencies F_p and F_s. An important consequence of this specification is that neither the passband cutoff frequency F_p nor the stopband cutoff frequency F_s can be initially prescribed. As a result with fixed-order (2N+1), fixed δ_p, and fixed δ_s, there are only N unique values that N_p can assume. Since a unique value of N_p implies a unique pair of cutoff frequencies, F_p and F_s, there are, under these constraints, only N different filters available. In order to cover a broader range of possible cutoff frequencies it is necessary to vary one, or any combination, of the other filter parameters N, δ_p, and δ_s. The value of the parameter N can range over the set of positive integers, while the parameters δ_p and δ_s can assume a continuum of possible values. Hence, although it is not possible to prescribe the desired cutoff frequencies in advance, in practice any pair of frequencies can be obtained by proper specification of the other filter parameters. Significantly, the lowpass-lowpass transformation used to obtain any desired cutoff frequency for recursive filters is not applicable here, since it introduces poles into the filter transfer function and distorts the phase characteristic.

In compiling the set of reference designs presented in Appendix A there were two broad objectives. First, we wanted to cover as wide a range of design specifications as possible so that many of the standard filters used in practice could be incorporated in the tables and so that the validity of the design algorithm could be tested. Second, we wished to vary the various filter parameters in increments small enough that there would be no large gaps in the data presented. Given a fixed amount of computer time with which to fulfill these objectives, it is apparent that they presented conflicting goals. Nevertheless, guided by previously tabulated analog filter designs,[11] intuition, and preliminary research data, a choice was made as to the range of values of the design parameters.

The parameter N was allowed to assume the values 5, 7, 10, 15, 31, 63, and 127, corresponding to filter orders of 11, 15, 21, 31, 63, 127, and 255. Note that for the higher order filters the length of the unit sample response (2N+1) was chosen as the next lowest integer to a power of 2. This choice of values facilitates the implementation of these filters when realized by the fast Fourier transform or when used as finite duration-time windows for spectral analysis and estimation. Proportionally fewer high-order filters were included in the tables because they required significantly more computer time than low-order solutions. It would be totally inaccurate to conclude from the selected list of values that the design algorithm failed to converge for the high-order cases. In fact, it converged quite rapidly, within 7 iterations, for filters of order 255, and there is no indication that it cannot handle filters of even higher order.

As previously mentioned, with the filter order fixed at a particular value there are exactly N unique values N_p can assume. For the low-order filters ($N \leq 10$) N_p was allowed to take on all of its possible values. To economize on costs, however, for values of N larger than 10, N_p was restricted in the values that it could assume. In particular, for all but the very highest order cases, N_p was restricted to a set of 6 possible values chosen so that an approximately uniform increment in F_p resulted.

The two parameters δ_p and δ_s, which define the maximum ripple heights, can assume a continuum of possible values. Clearly, it was impossible to present filters for every value of δ_p or δ_s, and thus it was necessary to choose a few practical values for representation. Previous designs, both analog[11] and digital,[4] indicate that the passband ripple specification δ_p is less critical than the stopband ripple specification. Thus for the major part of the tabulations δ_p was allowed to vary over a set of only three possible values 0.01, 0.0031623, or 0.001 which correspond to allowed deviations about unity of 1%, 0.31623%, and 0.1%. Although the second value may appear awkward to specify, this value is necessary to complete a class of filter specifications not explicitly represented in the tables. This will be explained in Section VII. For the high-order cases ($N=63$ and $N=127$) δ_p was restricted to either of two values 0.01 or 0.001. Similarly, for most of the designs δ_s was allowed to range over the set of 5 values 0.01, 0.0031623, 0.001, 0.00031623, and 0.0001 corresponding to stopband attenuations of −40 dB, −50 dB, −60 dB, −70 dB, and −80 dB. For the high-order cases it too was limited in its range to values of 0.01, 0.001 or 0.0001.

The resulting filter designs exhibit normalized cutoff frequencies that vary in the passband from 0.00268 to 0.41665, and in the stopband from 0.06963 to 0.49917. The resulting range of transition bandwidths is from 0.01003 to 0.30236, and is an extremely sensitive function of the filter order.

V. LAYOUT OF DESIGN TABLES AND DESIGN CURVES

A listing of all tabulated designs is presented in Appendix A. Each numbered entry represents a unique design which is specified in terms of the four initially prescribed filter parameters, the two cutoff frequencies, and the resulting transition bandwidth. For example, filter 304 is presented as

No.	N	NP	DELTAP	DELTAS	FP	FS	TBW
304.	15	7	0.01	0.01	0.18552	0.24906	0.06353

The use of a unique call number for each filter permits the data to be easily retrieved from the tables.

The order in which the filters are presented has been chosen to aid the filter designer in locating a desired specification. Within the class of filters of a particular order, the initial grouping has N, N_p, and δ_p fixed at their minimum values. δ_s is then allowed to range in decreasing order over its set of prescribed values. In the next grouping N and N_p remain unchanged while δ_p is incremented to the next largest value and δ_s is again allowed to range over its possible values in decreasing order. This routine continues in exactly the same manner until δ_p has assumed its largest possible value. At this point N_p is incremented to a successively larger value and the entire process is repeated, first with δ_s decreasingly ranged, and then δ_p increasingly ranged. The final stage of variation occurs after this last step has been completed for the largest prescribed value of N_p within the class. When this has occurred the class of filters of that particular order has been exhausted and it is necessary to increment the value of N before proceeding further.

The tabulated designs have been presented in this manner to achieve a consistent progression of the filter cutoff frequencies. In particular, for filters of a specified order, examination of the columns headed F_p and F_s reveals that the passband cutoff frequency consistently increases as one reads down successive lines of a page, and that the stopband cutoff frequency consistently increases over the ranges where N, N_p, and δ_p are constant. This arrangement should assist the filter designer, faced with a specification prescribing one or both of the cutoff frequencies, to find a solution to his problem.

Note that there are two main listings within Appendix A. The first includes filters 1-442 and is the main body of the catalogued reference designs. It represents designs that fall within the parameter ranges discussed above. A set of design curves to be used in conjunction with this listing is presented in Appendix B. In order to preserve the continuity of the tables it was necessary to include a second listing which presents filter designs 443-535. For the most part these designs were tabulated in the early stages of this research and were generated to verify the initial results and provide guidance, rather than to be an integral part of the finished tables. For this reason, there are no design curves corresponding to these filters and it may seem that they have been tabulated with no consistent pattern in mind.

The design curves in Appendix B were derived from the main body of reference designs 1-442. The range of filter parameters covered by these curves is exactly the same as that covered by the tables, but the data are arranged somewhat differently. Specifically, these curves were included to provide the filter designer with first-order information about how the two cutoff frequencies vary with the ripple heights and the parameter N_p. For each class of filters of a particular order essentially four different sets of design curves are presented. The first two sets present plots of F_p and F_s vs δ_p with fixed parameters N and δ_s. The second two sets show how F_p and F_s vary with δ_s while N and δ_p are held constant. Within each set of curves N_p is a parameter that is allowed to range over all of its prescribed values.

The arrangement of these curves within Appendix B is as follows. Initially the curves are grouped according to filter order. That is, all design curves with N = 5 are presented first; next curves with N = 7 are displayed, and so on until curves for the largest value of N have been presented. Within each grouping of a constant N value the curves are arranged so that first plots of F_p and F_s vs δ_s are presented with δ_p fixed at its smallest value. Similar sets of curves are then presented with δ_p increasingly incremented. After δ_p has assumed all of its prescribed values, plots of F_p and F_s vs δ_p are presented with δ_s fixed at progressively smaller values. This arrangement, like that of the tables, provides a certain degree of consistency in the variation of the cutoff frequencies within each grouping of curves, and hence enables the designer to solve his design problem more easily than would otherwise be possible.

Observation of a particular set of design curves, say, Fig. B-15a and B-15b, reveals that the parameters actually plotted, with the exception of N_p, are the negative base 10 logarithms of those mentioned above. The reason for this is twofold. First, we wanted to cover a large range of parameter values in a fairly precise manner and the logarithmic scales made this possible. Second, we found that the design curves when plotted on logarithmic scales exhibited essentially linear relations over many of the prescribed parameter ranges. As a result, at least to a first approximation, a linear interpolation can be used between points on the curves to obtain a design not explicitly catalogued.

Thus far the designs tabulated in Appendix A and displayed in Appendix B have been specified only in terms of the four design parameters N, N_p, δ_p, δ_s, and the two resulting cutoff frequencies F_p and F_s. For the designer wishing to implement a particular design, a further specification, in terms of the filter unit sample response, is needed. Appendix C presents the unit sample response for each of the filters listed in Appendix A. Each filter is referenced by the same call number in both appendices. The unit sample response of the zero-phase filter, which is an even function of length 2N+1 samples, can be completely specified by N+1 appropriate values. Specifically, this unit sample response $h_o(n)$ has been tabulated for $n = 0, 1, 2, \ldots, N$. Because $h_o(n) = h_o(-n)$; $n = 1, 2, \ldots, N$ and because the unit sample response h(n) of the linear phase filter is just that of the zero-phase filter delayed by N samples it can be found directly from $h_o(n)$ as

$$h(n) = h_o(n-N) \qquad n = 0, 1, 2, \ldots, 2N. \tag{12}$$

Thus the information in Appendices A-C serves to specify completely all of the tabulated designs.

It will become evident from examination of the design curves and tables that only filters with $\delta_p \geq \delta_s$ have been tabulated, and that with $\delta_p = \delta_s$ designs were presented only for values of $N_p \leq N_s$. The reason for this is that the reciprocal sets of filters can easily be derived from those already tabulated by simple transformations that will be described in Section VII.

VI. FORMULAS FOR ESTIMATING DESIGN PARAMETERS

Before discussing how the design curves and tables can be applied in practice it will be helpful to present a few approximate relations that will facilitate their use. The tabulated designs are uniquely specified by the four parameters N, N_p, δ_p, and δ_s. If the designer can formulate his problem in terms of these specifications he will be able to retrieve the solution from the tables and curves in a straightforward manner. The design problem, however, is usually phrased in terms of F_p, F_s, δ_p, and δ_s, or in terms of one of the cutoff frequencies, say F_p, the maximum transition bandwidth allowed, and δ_p and δ_s. In either case the designer must determine appropriate values of N and N_p to arrive at a particular solution. Although the design curves and tables have been arranged to facilitate this procedure, it would be unnecessarily tedious to have to sort through the complete set of tabulated designs to arrive at one solution. What is needed is a set of simple, approximate expressions that relate the parameters N and N_p to the others mentioned. By using these expressions, the designer can more readily decide just where in the set of design curves he should begin searching for a solution. Formulas 13 and 14, although yielding only rough estimates, have been found to be quite useful in this respect.

Herrmann[6] has found the standard figure of merit $D(N, N_p, \delta_p, \delta_s) \triangleq 2N(F_s - F_p)$ to be essentially independent of N and N_p for values of $N \geq 15$. He has defined the quantity $D_o(\delta_p, \delta_s)$ for $n \geq 15$, and has empirically determined that

$$D_o(\delta_p, \delta_s) = 2N(F_s - F_p) \cong 0.55\,(1 + \log_{10}\delta_p)\log_{10}\delta_s + 0.9\log_{10}\delta_p + 2.7. \tag{13}$$

Furthermore, it has been found that

$$\frac{N_p}{N+1} \cong \frac{F_p}{F_p + (0.5 - F_s)}. \tag{14}$$

VII. USE OF DESIGN CURVES AND TABLES

The best way to illustrate how a designer might go about using the tables and curves in Appendices A-C is to present examples of solutions for a few typical designs.

7.1 LOWPASS-FILTER DESIGN

Example 1

Consider the design of a linear-phase, equiripple, nonrecursive digital filter specified to have a magnitude frequency response that is flat to within 1% of unity for all frequencies up to 0.193 and that has a stopband attenuation of at least −55 dB for frequencies beyond 0.360. First, note that the frequencies must be specified in terms of the normalized frequency variable F. If f represents the analog frequency, and T is the sampling period, then

$$F = fT. \tag{15}$$

Once the frequencies have been properly prescribed, the other specifications must be transcribed into the terminology used in the tables. For Example 1 they become F_p = 0.193, F_s = 0.360, δ_p = 0.01, and δ_s = 0.001. Since no −55 dB filters were tabulated, we decided to use a design with a −60 dB stopband attenuation. Use of the design curves requires the additional conversion of some of these parameters into their base 10 logarithms. The resulting specifications are $-\log_{10} F_p = 0.714$, $-\log_{10} F_s = 0.444$, $-\log_{10} \delta_p = 2$, and $-\log_{10} \delta_s = 3$.

The next step is to use Eqs. 13 and 14 to see where in the set of design curves the solution might be located. From Eq. 13 the value of N is estimated as approximately 7.5. The nearest value for which designs have been tabulated is N = 7. Using N = 7 in Eq. 14 results in an estimated N_p of 4.6. We then restrict our attention to the subset of design curves, Fig. B-11, in which N = 7 and δ_p = 0.01, or to the subset, Fig. B-14, in which N = 7 and δ_s = 0.001. The solution is seen to lie on the curves with N_p = 4. Specifically, one of the tabulated designs, denoted on the curves by ● and ▲ points, fits the specifications almost exactly.

The four parameters sufficient to uniquely specify this tabulated design are N = 7, N_p = 4, δ_p = 0.01, and δ_s = 0.001. By using these four specifications, the exact design solution may be found listed in Appendix A as filter 100, with cutoff frequencies F_p = 0.19304, F_s = 0.36032, and a transition bandwidth TBW = 0.16728. To complete the solution of this design problem, it is only necessary for the designer to locate the zero-phase filter unit sample response referenced under No. 100 in Appendix C and use Eq. 12 to transform it into the unit sample response of a linear phase filter. It can be verified from the design curves that this solution represents the lowest order solution tabulated for the desired specifications.

Example 1 was somewhat oversimplified because the original specifications were chosen to match a tabulated design and hence to yield a straightforward solution of the problem. If a designer is faced with an initial specification of the two ripple tolerances δ_p and δ_s, the passband cutoff frequency F_p, and the maximum allowable transition bandwidth TBW_{max}, all randomly prescribed, there is no guarantee that a unique design can be found from these tables. It may be necessary to make tradeoffs between several tabulated designs to arrive at a compromise solution. Alternatively, if none of the catalogued designs are acceptable, the designer could use the design curves, tables, and the initial filter specifications to arrive at a set of suitable design parameters that would yield a computer solution to his problem. Most of these concepts are illustrated in Example 2.

Example 2

Consider the design of a nonrecursive, linear-phase, equiripple lowpass digital filter specified to have a maximum allowable passband ripple of 1% about unity out to a passband cutoff frequency of 0.1140. The stopband attenuation is prescribed to be at least -60 dB, and the transition bandwidth must be 0.0475 or less. With these specifications, it is understood that the lowest order filter satisfying these tolerances will be the accepted solution. The design specifications of interest are the following.

$F_p = 0.1140, \qquad -\log_{10} F_p = 0.9431$

$F_s \leq 0.1615, \qquad -\log_{10} F_s \geq 0.7918$

$\delta_p \leq 0.01, \qquad -\log_{10} \delta_p \geq 2.0$

$\delta_s \leq 0.001, \qquad -\log_{10} \delta_s \geq 3.0$

Since a fairly narrow transition band has been specified, it is expected that the design solution will be of a relatively high order. By using Eq. 13, the parameter N is estimated as approximately 27. The nearest value of N for which designs have been tabulated is N = 31. Also, with N = 31, Eq. 14 estimates N_p as approximately equal to 8. If we turn to Appendix B and locate Fig. B-36, with fixed parameters N = 31 and δ_p = 0.01, we find that a solution does indeed exist along the curves labeled N_p = 8. None of the tabulated designs exactly fits the specifications, however. The designer must now choose one of the closest tabulated solutions or use the curves to predict the parameters that are necessary for a computer solution. The alternatives evident from these curves are listed below as filter 356, or 357 (Appendix A).

Filter No.	N	N_p	δ_p	δ_s	F_p	F_s	TBW
356	31	8	0.01	0.001	0.11226	0.15363	0.04137
357	31	8	0.01	0.00031623	0.11496	0.16137	0.04640

Notice that filter 356 achieves all of the desired specifications except for F_p, and that filter 357 achieves the specified F_p much more closely but has a stopband attenuation of −70 dB. The designer would probably settle for one of these designs, but if he required F_p to be obtained more exactly, he could use the design curves to obtain the necessary design specifications. Specifically, from Fig. B-36a it is found that the value of δ_s necessary to achieve an $F_p = 0.114$ with $N = 31$, $N_p = 8$ and $\delta_p = 0.01$ is $\delta_s = 0.5624 \times 10^{-3}$. The resulting values for F_s and TBW may be found from Fig. B-36b to be $F_s = 0.1560$ and TBW = 0.0420. Hence the computer solution could be specified in terms of $N = 31$, $N_p = 8$, $\delta_p = 0.01$ and $\delta_s = 0.0005624$.

All of the designer's alternatives have not yet been exhausted. Additional designs that fit the desired specifications can be found from Fig. B-40 where the fixed parameters are $N = 31$ and $\delta_s = 0.00031623$. In particular, the curves in which $N_p = 8$ indicate that a solution exists for the specified F_p, with $\delta_p = 0.008890$, $F_s = 0.1605$, and TBW = 0.0465. Hence a second computer solution exists with specifications $N = 31$, $N_p = 8$, $\delta_p = 0.008890$, and $\delta_s = 0.00031623$. Still other possible solutions could be found by looking within the same set of curves at subsets where δ_p and δ_s assume other satisfactory values. Since the procedure has already been thoroughly demonstrated, these solutions will not be found explicitly. The remaining filter specification, which is the unit sample response, can be found from Eq. 12 and Appendix C if the designer accepts one of the tabulated filters or from the computer solution if he does not.

7.2 DESIGN OF FILTERS DERIVABLE FROM LISTINGS

As we have mentioned, designs have been tabulated only for values of $\delta_p \geq \delta_s$. We shall now present a method by which the reciprocal designs, $\delta_p < \delta_s$, can be obtained. Consider the zero-phase, equiripple lowpass characteristic presented in Fig. 3. It is prescribed to have certain design parameters N_p, N_s, δ_p, and δ_s, as well as a pair of cutoff frequencies F_p and F_s. In terms of the filter unit sample response $h_o(k)$, the characteristic is defined as

$$H_o(F) = \sum_{k=-N}^{N} h_o(k)\, e^{-j2\pi Fk}. \tag{16}$$

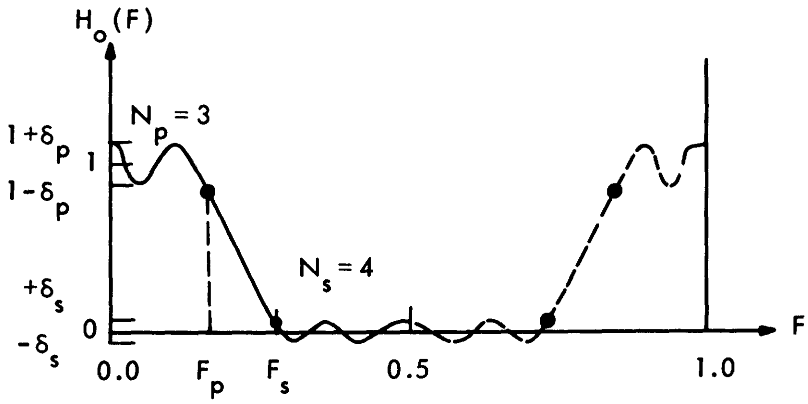
In Fig. 4 a new frequency characteristic $H_o'(F)$ is formed by subtracting $H_o(F)$ from unity. This new characteristic is a highpass design defined by

$$H_o'(F) = 1 - H_o(F)$$

and (17)

$$H_o'(F) = \sum_{k=-N}^{N} h_{ho}(k)\, e^{-j2\pi Fk},$$

where the new unit sample response $h_{ho}(k)$ is related to $h_o(k)$ by

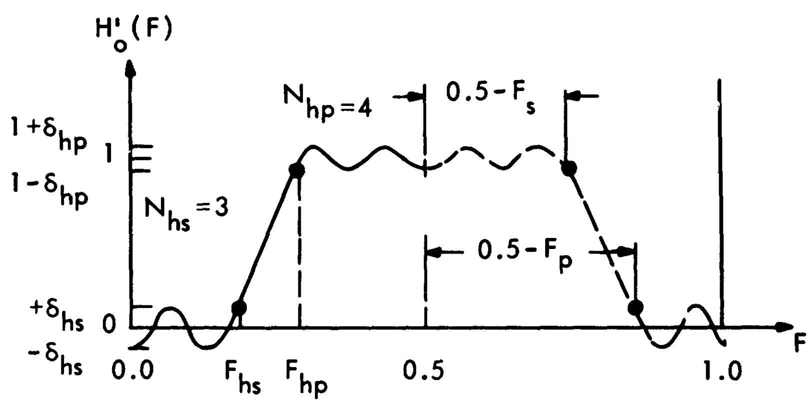


$$H_o(F) = \sum_{k=-N}^{N} h_o(k)\, e^{-J2\pi Fk}$$

$$h_o(k) = 0 \quad |k| > N$$

$$\delta_p \geq \delta_s$$

Fig. 3. Equiripple lowpass filter frequency response.



$$H'_o(F) = 1 - H_o(F)$$

$$H'_o(F) = \sum_{k=-N}^{N} h_{ho}(k)\, e^{-J2\pi Fk}$$

$$h_{ho}(k) = \begin{cases} 1 - h_o(0) & k = 0 \\ -h_o(k) & k \neq 0 \end{cases}$$

$$F_{hs} = F_p \; ; \; F_{hp} = F_s$$

$$\delta_{hs} = \delta_p \; ; \; \delta_{hp} = \delta_s$$

$$\delta_{hs} \geq \delta_{hp}$$

Fig. 4. Transformed highpass filter frequency response.

$$h_{ho}(k) = \begin{cases} 1 - h_o(0) & k = 0 \\ -h_o(k) & k = -N, \ldots, N; \quad k \neq 0 \end{cases} \tag{18}$$

The final construction is shown in Fig. 5 where a third frequency characteristic $H_o''(F)$ is formed by rotating $H_o'(F)$ through a frequency shift $\Delta F = 0.5$. Since a frequency shift of ΔF corresponds to multiplication of the unit sample response by a factor $e^{j2\pi\Delta Fk}$, the new characteristic can be described by

$$H_o''(F) = H_o'(F-0.5) = \sum_{k=-N}^{N} h_o''(k)\, e^{-j2\pi Fk}, \tag{19}$$

where

$$h_o''(k) = \begin{cases} (-1)^k\, h_{ho}(k); & k = -N, \ldots, 0, \ldots, N \\ 0 & |k| > N \end{cases} \tag{20}$$

Observation of Figs. 5 and 3 yields the desired results. Figure 5 represents a zero-phase, equiripple, lowpass characteristic, but the new filter parameters N_p'', N_s'', δ_p'', δ_s'', F_p'', and F_s'' are different from those of Fig. 3. Specifically, it is found that they are related by

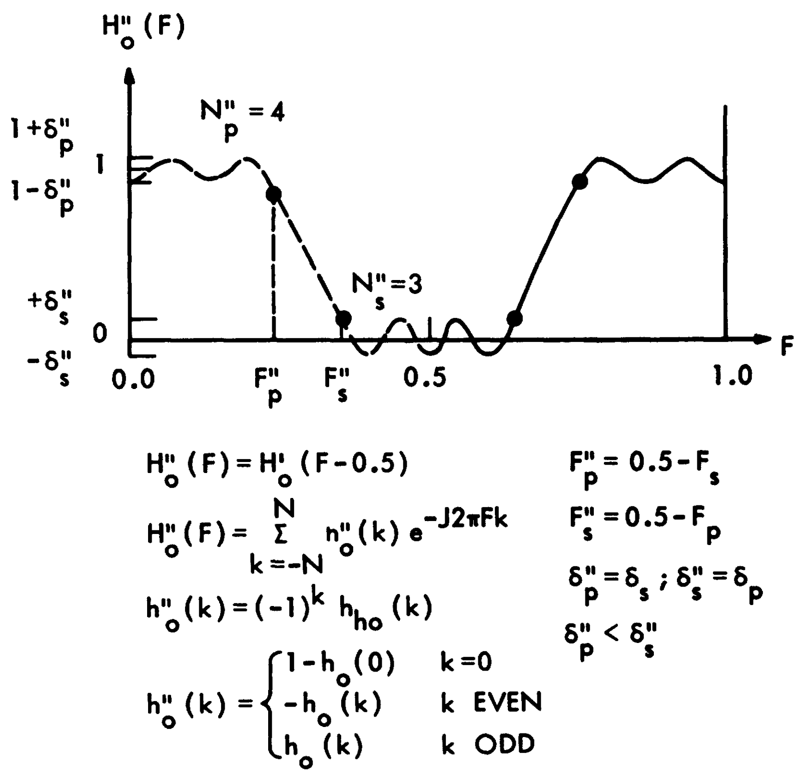


Fig. 5. Transformed equiripple lowpass filter frequency response.

$$N''_p = N_s, \qquad N''_s = N_p \tag{21}$$

$$\delta''_p = \delta_s, \qquad \delta''_s = \delta_p \tag{22}$$

$$F''_p = 0.5 - F_s, \qquad F''_s = 0.5 - F_p. \tag{23}$$

From Eqs. 20 and 18 the unit sample response corresponding to the characteristic of Fig. 5 is related to that of Fig. 3 by

$$h''_o(k) = \begin{cases} 1 - h_o(0) & k = 0 \\ -h_o(k) & k \text{ even} \\ h_o(k) & k \text{ odd} \\ 0 & |k| > N \end{cases} \tag{24}$$

Equations 21-24 enable the designer to obtain solutions for values of $\delta''_p < \delta''_s$ from values already tabulated. A specific example will serve to illustrate the concepts.

Example 3

Consider the design of an eleventh-order (N=5) linear-phase, equiripple, nonrecursive, lowpass digital filter with the specifications $N''_p = 4$, $N''_s = 2$, $\delta''_p = 0.001$, and $\delta''_s = 0.01$. Since $\delta''_p < \delta''_s$, it is necessary to use the procedure just outlined. Equations 21 and 22 give the specifications of the reciprocal filter as $N_p = 2$, $N_s = 4$, $\delta_p = 0.01$, and $\delta_s = 0.001$. This filter, referenced as No. 22 in Appendix A, has cutoff frequencies $F_p = 0.08568$, and $F_s = 0.30889$ which result in a transition bandwidth of TBW = 0.22321. Its unit sample response is found from Appendix C to be $h_o(0) = 0.360960841$, $h_o(1) = 0.275038898$, $h_o(2) = 0.101413727$, $h_o(3) = -0.015755489$, $h_o(4) = -0.034144104$, $h_o(5) = -0.012033358$, and $h_o(k) = h_o(-k)$; $k = 1, 2, \ldots, 5$. By using these results and Eqs. 23 and 24, the solution to the design problem is a filter specified as $N''_p = 4$, $N''_s = 2$, $\delta''_p = 0.001$, $\delta''_s = 0.01$ with cutoff frequencies $F''_p = 0.19111$, $F''_s = 0.41432$, the same transition bandwidth as before, and a unit sample response of $h''_o(0) = 0.639039159$, $h''_o(1) = 0.275038898$, $h''_o(2) = -0.101413727$, $h''_o(3) = -0.015755489$, $h''_o(4) = 0.034144104$, $h''_o(5) = -0.012033358$, and $h''_o(k) = h''_o(-k)$; $k = 1, 2, \ldots, 5$. This unit sample response can again be shifted by Eq. 12 to obtain a linear-phase filter.

It is now evident why it was necessary to tabulate designs only for values of $N_p \leqslant N_s$ when the parameters δ_p and δ_s were prescribed as equal. Designs with $N_p > N_s$ and $\delta_p = \delta_s$ can be obtained from the tabulated filters exactly as in this example.

7.3 HIGHPASS FILTER DESIGN

The frequency response of an ideal highpass filter is shown in Fig. 6 to be zero in the stopband and unity in the passband. As in the case of a lowpass design, this ideal characteristic is not realizable in practice. An equiripple approximation to this highpass characteristic is shown in Fig. 7. The important specifications of this design are

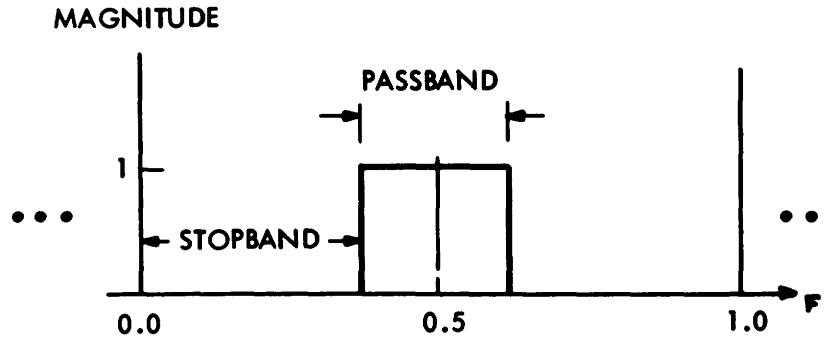


Fig. 6. Ideal highpass filter frequency response.

the two ripple heights, δ_{hs} in the stopband and δ_{hp} in the passband; N_{hs}, the number of stopband ripples; N_{hp}, the number of passband ripples; F_{hs}, the stopband cutoff frequency; and F_{hp}, the passband cutoff frequency. Again $N = N_{hp} + N_{hs} - 1$, since the ripples at $F = 0.0$ and $F = 0.5$ are included in the specifications.

Each of the lowpass designs in Appendix A can be transformed into two highpass designs of the same order that retain their equiripple characteristics and linear phase. Consider again the zero-phase, equiripple, lowpass characteristic of Fig. 3. The pertinent specifications are N_p, N_s, δ_p, δ_s, F_p, F_s, and the unit sample response $h_o(k)$, $k = -N, \ldots, 0, \ldots, N$. One procedure (method 1) by which this characteristic can be transformed to a highpass design has been demonstrated in conjunction with Fig. 4. The highpass frequency characteristic $H_o'(F)$ is related to the lowpass characteristic $H_o(F)$

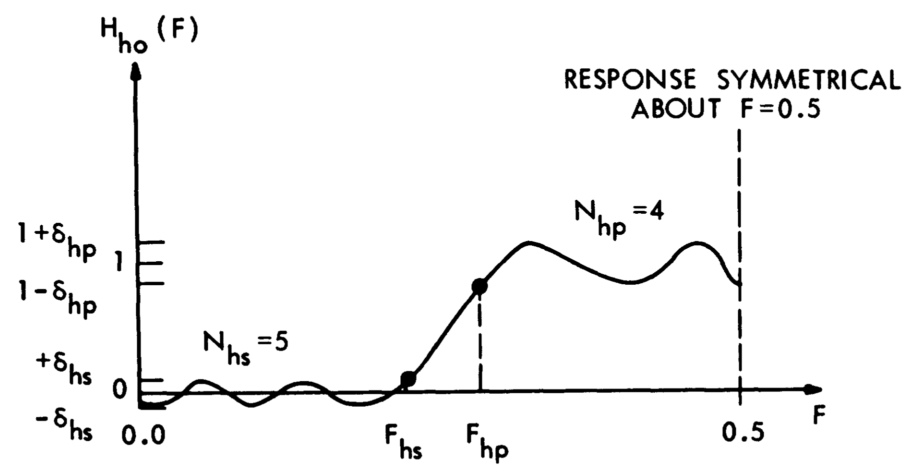
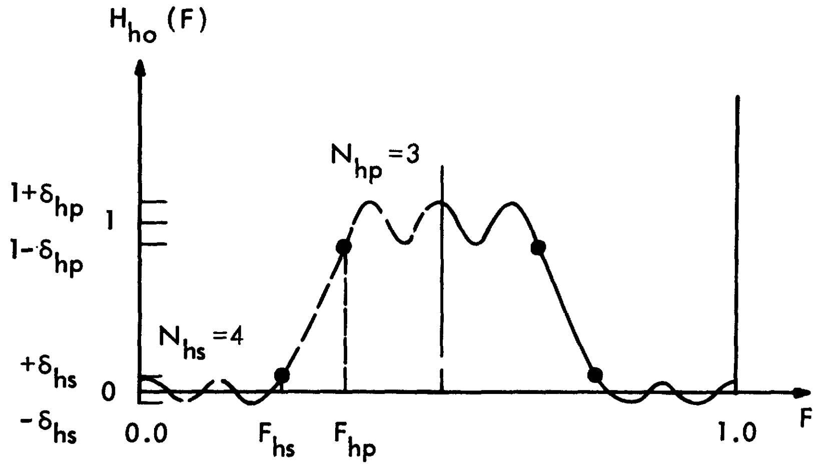


Fig. 7. Equiripple approximation to ideal highpass design.



$$H_{ho}(F) = H_o(F-0.5) \qquad F_{hs} = 0.5 - F_s\ ;\ F_{hp} = 0.5 - F_p$$

$$H_{ho}(F) = \sum_{k=-N}^{N} h_{ho}(k)\, e^{-J2\pi Fk} \qquad N_{hp} = N_p\ ;\ N_{hs} = N_s$$

$$\delta_{hs} = \delta_s\ ;\ \delta_{hp} = \delta_p$$

$$h_{ho}(k) = (-1)^k\, h_o(k) \qquad \delta_{hp} \geq \delta_{hs}$$

Fig. 8. Rotated equiripple highpass filter frequency response.

by Eq. 17 and the highpass design specifications are found from the lowpass specifications to be

$$F_{hs} = F_p, \qquad F_{hp} = F_s \tag{25}$$

$$N_{hs} = N_p, \qquad N_{hp} = N_s \tag{26}$$

$$\delta_{hs} = \delta_p, \qquad \delta_{hp} = \delta_s. \tag{27}$$

Note that method 1 is applicable only for values of $\delta_{hs} \geqslant \delta_{hp}$, since designs have been tabulated only for values of $\delta_p \geqslant \delta_s$. As before, it can be verified that the highpass unit sample response $h_{ho}(k)$ is found from that of the lowpass filter by

$$h_{ho}(k) = \begin{cases} 1 - h_o(k) & k = 0 \\ -h_o(k) & k = -N, \ldots, N \quad k \neq 0 \\ 0 & |k| > N \end{cases} \tag{28}$$

Another way (method 2) by which a tabulated lowpass design can be transformed into a highpass filter is demonstrated in Fig. 8 where the lowpass characteristic of Fig. 3 has been rotated through a frequency shift $\Delta F = 0.5$. The resulting highpass characteristic exhibits design parameters related to the lowpass parameters through

$$F_{hs} = 0.5 - F_s, \qquad F_{hp} = 0.5 - F_p \tag{29}$$

$$N_{hs} = N_s, \qquad N_{hp} = N_p \tag{30}$$

$$\delta_{hs} = \delta_s, \qquad \delta_{hp} = \delta_p \tag{31}$$

and has a unit sample response $h_{ho}(k)$ which is obtained from $h_o(k)$ as

$$h_{ho}(k) = \begin{cases} (-1)^k h_o(k) & |k| \leq N \\ 0 & |k| > N \end{cases} \tag{32}$$

Again, since lowpass designs have been tabulated only for $\delta_p \geq \delta_s$, method 2 is applicable only when $\delta_{hp} \geq \delta_{hs}$. Another example will demonstrate the pertinent concepts.

Example 4

Consider the design of an 11^{th}-order, linear-phase, equiripple, nonrecursive highpass digital filter specified to have a magnitude frequency response with a stopband attenuation of at least -60 dB out to $F_{hs} = 0.112$, and which is flat to within 1% of unity beyond $F_{hp} = 0.331$. For this case, $\delta_{hs} = 0.001$, $\delta_{hp} = 0.01$, and $\delta_{hp} > \delta_{hs}$, so that method 2 can be used.

The first step in the solution of the problem is to translate these highpass specifications into an appropriate lowpass design so that the design curves and tables of Appendices A-C can be used. The resulting lowpass specifications found through Eqs. 29-31 are $N = 5$, $\delta_p = 0.01$, $\delta_s = 0.001$, $F_p = 0.169$, and $F_s = 0.388$. By using Eq. 14, we estimate the parameter N_p to be approximately 3.6. The next step is to locate the specified lowpass design on the design curves of Appendix B. In particular, Fig. B-3 reveals that the solution lies on the curves with $N_p = 3$, and that one of the tabulated filters meets the specifications almost exactly. This filter, No. 34 in Appendix A, has design parameters $N = 5$, $N_p = 3$, $\delta_p = 0.01$, $\delta_s = 0.001$, $F_p = 0.16920$, and $F_s = 0.38818$. Transformation of these statistics back to the corresponding highpass design by Eqs. 29-31 yields a final design solution with parameters N, δ_{hp}, and δ_{hs} exactly as specified, and cutoff frequencies $F_{hs} = 0.11182$ and $F_{hp} = 0.33080$. The unit sample response corresponding to this zero-phase highpass solution is found from Eq. 32 and filter No. 34 listing in Appendix C to be $h_{ho}(0) = 0.528105617$, $h_{ho}(1) = -0.302931309$, $h_{ho}(2) = -0.022480451$, $h_{ho}(3) = 0.067077279$, $h_{ho}(4) = 0.010677606$, $h_{ho}(5) = -0.016895719$, and $h_{ho}(-k) = h_{ho}(k)$; $k = 1, 2, \ldots, 5$. Again, the unit sample response $h_h(k)$; $k = 0, 1, \ldots, 2N$ associated with the corresponding linear-phase highpass filter can be found from

$$h_h(k) = h_{ho}(k-N); \qquad k = 0, 1, \ldots, 2N. \tag{33}$$

In this example the original highpass specifications were chosen so that a solution followed in a straightforward manner. If they had not been so chosen; that is, if they had been less complete or if they had been such that the derived lowpass specifications could not have been exactly satisfied by any of the tabulated designs, a solution could nevertheless have been found. By using the derived lowpass specifications, the designer, in this case, could have followed the procedures outlined in Example 2 to arrive at a compromise solution employing one of the explicitly tabulated filters. Alternatively, he could have obtained the parameters necessary for a computer solution of the problem.

7.4 NONLINEAR-PHASE FILTER DESIGN

Herrmann and Schuessler[7] have presented a method by which equiripple, nonrecursive digital filters with linear phase can be transformed into minimum-phase filters which retain their equiripple band characteristics. This method begins with the transfer function of the linear phase filter H(z) as expressed in Eqs. 1-3. Then a new transfer function $H_1(z)$ is defined through the relations

$$H_1(z) = H(z) + \delta_s \frac{1}{z^N}, \tag{34}$$

$$|H_1(F)| = H_o(F) + \delta_s, \tag{35}$$

and is seen to be strictly non-negative. Because the zero locations of the mirror-image polynomial $H_o(F)$ occur in complex conjugate, reciprocal pairs, this new magnitude function $H_1(F)$ can be recognized as a square. The minimum-phase transfer function is obtained by choosing all of the zeros of $H_1(z)$ inside the unit circle, half of the poles of $H_1(z)$ at the origin, and a simple zero at the points on the unit circle where $H_1(z)$ has double zeros. This construction beginning with a linear-phase filter of order 2N+1 yields a resulting design of order N+1. More generally, this procedure is amenable to the design of filters with other types of phase characteristics. Rather than choosing the zeros as above, proper factoring of the transfer function $H_1(z)$ can yield a number of possible squared magnitude functions, and hence a number of different phase responses. As a practical matter, however, this method requires finding the zero locations of an N^{th}-order polynomial, and hence is restricted to designs of relatively low-order filters.

7.5 INTERPOLATION ON THE DESIGN CURVES

As demonstrated in Example 2, the design curves of Appendix B can be used to estimate the design parameters of a filter that has not been explicitly tabulated and whose solution requires a computer implementation of the design algorithm. Observation of the curves, especially for values of $N \geq 15$, reveals that they are approximately linear over most parameter ranges of interest, and suggests an alternative procedure for estimating the design parameters of filters that are not listed in the tables. In particular, points on the curves between adjacent catalogued solutions can be found by using a linear interpolation of the form

$$\log_{10} F_i = A \log_{10} \delta_j + B, \tag{36}$$

where the subscripts i and j assume the values p or s depending on the design curve in question, and the constants A and B are determined from the known values of F_i and δ_j at two adjacent design points.

To demonstrate this procedure, consider the design problem posed in Example 2. The pertinent design specifications are $F_p = 0.1140$, $F_s \leq 0.1615$, $\delta_p \leq 0.01$, and $\delta_s \leq 0.001$. We found in this example that none of the tabulated designs met the original specifications exactly. Let us assume that the alternative designs presented were therefore unacceptable, and use Eq. 36 to estimate the parameters of a computer solution. Figure B-40 with $N = 31$, $\delta_s = 0.00031623$, and $N_p = 8$ reveals that the desired design falls between tabulated filters No. 352 and No. 357. By using the values of F_p and δ_p listed for these filters in Appendix A, the constants of Eq. 36 are found to be $A = 0.06550$ and $B = -0.80845$. Next, using these values and the original specification of $F_p = 0.1140$ in Eq. 36, we can solve for the necessary value of the parameter δ_p. We find that $\delta_p = 0.008796$ and that the computer solution can be specified in terms of the parameters $N = 31$, $N_p = 8$, $\delta_p = 0.008796$, and $\delta_s = 0.00031623$.

For the cases that we have tested, use of Eq. 36, in conjunction with specifications derived from the listings in Appendix A, has resulted in estimates of the logarithm of an unknown parameter accurate to approximately ± 0.0005. To see what this means in terms of the parameter itself, let F_p be the precise value of the unknown parameter, and $\hat{F}_p$ be the estimated value. Then in terms of $\log_{10} F_p$ Eq. 36 yields an estimate, $\log_{10} \hat{F}_p$, which is accurate to ± 0.0005. That is,

$$\log_{10} \hat{F}_p = \log_{10} (F_p) \pm 5 \times 10^{-4} \tag{37}$$

or

$$\hat{F}_p = 10^{\pm 5\times 10^{-4}} F_p. \tag{38}$$

But for small values of x, $10^{\pm x} \cong 1 \pm x \ln 10$, so that

$$\hat{F}_p \cong F_p(1 \pm 11.5 \times 10^{-4}). \tag{39}$$

Thus, by using Eq. 36, the estimated value of the unknown parameter has been found to be within ~0.0012 of its actual value.

It should be mentioned that this degree of accuracy can be obtained with Eq. 36 only when the desired solution lies on the most linear parts of the design curves. Specifically, it can be readily observed that the linearity of the design curves is much better for plots of $-\log_{10} F_p$ and $-\log_{10} F_s$ vs $-\log_{10} \delta_p$ than it is for plots of these parameters against $-\log_{10} \delta_s$. It is also apparent that the curves are most linear for large values of N_p and N and for small values of δ_p and δ_s.

VIII. CONCLUSION

There are at least six filter specifications of direct interest to the filter designer. These are the four design parameters N, N_p, δ_p, and δ_s that uniquely define a tabulated solution and the resulting two cutoff frequencies F_p and F_s. Faced with so many variables in a design problem, it is not easy for a designer to predict the effect of changing one or several of the specifications. In correlating the raw data collected for this report, we observed several modes of parameter variations that may be of use to the prospective filter designer. Although these results are not hard-and-fast rules that strictly apply in every case, they do provide the designer with several useful rules of thumb that will better enable him to develop a feeling for predicting the effects of certain parameter changes.

It has been found that with the parameters N, N_p, and δ_s fixed at constant values, as δ_p is allowed to increase both of the cutoff frequencies F_p and F_s increase also. As may be expected, F_p is more sensitive to changes in δ_p than is F_s, and therefore it increases at a faster rate. The net effect of increasing δ_p under these conditions is an increase in both cutoff frequencies and a slight decrease in transition bandwidth. Similarly, with the parameters N, N_p, and δ_p held constant both cutoff frequencies F_p and F_s decrease as δ_s is allowed to assume larger values. In this case F_s is the more sensitive function and the net result of increasing δ_s under this second set of conditions is a decrease in both cutoff frequencies, as well as in the transition bandwidth. Finally, it has been found that with the parameters δ_p and δ_s fixed and the ratio N_p/N held approximately constant as N is allowed to increase, the passband cutoff frequency increases, while the stopband cutoff frequency decreases. The result is that a significant decrease in transition bandwidth can be effected by suitably increasing the filter order. More specifically, under this last set of conditions we observed that doubling the value of the parameter N while keeping the ratio N_p/N constant resulted in approximately halving the transition bandwidth of the filter.

It is appropriate to mention two points that have not been touched upon. The first is that there has been no attempt in this report to derive a set of relations by which the unit sample response of a desired filter could be obtained as an interpolation on the unit sample response of a tabulated design. Although one would expect that such a set of relations may exist, the change in a filter unit sample response now seems to be a complicated function of the change in filter specifications. The second point concerns the effects of finite register length and coefficient inaccuracies. For all of the tabulated designs the unit sample response coefficients have been carried out to 9 decimal places in Appendix C. When a filter is practically realized, however, the computations may be made on a computer with a smaller word length or with special-purpose hardware that places a premium on the coefficient word length. As a result, filter coefficients will be rounded off and some change in the filter shape will occur. Preliminary results for a few low-order filters where the unit sample response coefficients were rounded off to a prescribed number of bits indicate that at least 14 and preferably 16 bits are needed to preserve the equiripple filter characteristics.

APPENDIX A

Design Tables

Lists of 535 lowpass-filter designs have been tabulated in this report. Each design is referenced by a unique number, and is specified by the four required design parameters N, N_p, δ_p and δ_s, as well as the two resulting cutoff frequencies F_p and F_s, and the width of the transition band TBW.

NO.	N	NP	DELTAP	DELTAS	FP	FS	TBW
1.	5	1	0.00100000	0.00100000	0.00504	0.22161	0.21656
2.	5	1	0.00100000	0.00031623	0.00533	0.24862	0.24329
3.	5	1	0.00100000	0.00010000	0.00548	0.27372	0.26824
4.	5	1	0.00316230	0.00316230	0.00853	0.19248	0.18395
5.	5	1	0.00316230	0.00100000	0.00900	0.22166	0.21266
6.	5	1	0.00316230	0.00031623	0.00941	0.24868	0.23927
7.	5	1	0.00316230	0.00010000	0.00975	0.27376	0.26401
8.	5	1	0.01000000	0.01000000	0.01399	0.16155	0.14756
9.	5	1	0.01000000	0.00316230	0.01516	0.19266	0.17750
10.	5	1	0.01000000	0.00100000	0.01608	0.22183	0.20575
11.	5	1	0.01000000	0.00031623	0.01684	0.24885	0.23201
12.	5	1	0.01000000	0.00010000	0.01750	0.27390	0.25640
13.	5	2	0.00100000	0.00100000	0.04832	0.30614	0.25782
14.	5	2	0.00100000	0.00031623	0.04949	0.33087	0.28138
15.	5	2	0.00100000	0.00010000	0.05038	0.35285	0.30247
16.	5	2	0.00316230	0.00316230	0.06234	0.27922	0.21688
17.	5	2	0.00316230	0.00100000	0.06438	0.30712	0.24274
18.	5	2	0.00316230	0.00031623	0.06596	0.33175	0.26579
19.	5	2	0.00316230	0.00010000	0.06717	0.35353	0.28636
20.	5	2	0.01000000	0.01000000	0.07930	0.25013	0.17083
21.	5	2	0.01000000	0.00316230	0.08290	0.28122	0.19833
22.	5	2	0.01000000	0.00100000	0.08568	0.30889	0.22321
23.	5	2	0.01000000	0.00031623	0.08778	0.33336	0.24558
24.	5	2	0.01000000	0.00010000	0.08946	0.35491	0.26545
25.	5	3	0.00100000	0.00100000	0.11645	0.38354	0.26708
26.	5	3	0.00100000	0.00031623	0.11778	0.40361	0.28584
27.	5	3	0.00100000	0.00010000	0.11880	0.42030	0.30149
28.	5	3	0.00316230	0.00316230	0.13822	0.36177	0.22355
29.	5	3	0.00316230	0.00100000	0.14057	0.38540	0.24483
30.	5	3	0.00316230	0.00031623	0.14206	0.40514	0.26308
31.	5	3	0.00316230	0.00010000	0.14318	0.42156	0.27838
32.	5	3	0.01000000	0.01000000	0.16255	0.33745	0.17490
33.	5	3	0.01000000	0.00316230	0.16647	0.36504	0.19858
34.	5	3	0.01000000	0.00100000	0.16920	0.38818	0.21898
35.	5	3	0.01000000	0.00031623	0.17106	0.40747	0.23641
36.	5	3	0.01000000	0.00010000	0.17236	0.42350	0.25114
37.	5	4	0.00100000	0.00031623	0.19442	0.46374	0.26932
38.	5	4	0.00100000	0.00010000	0.19473	0.47291	0.27818
39.	5	4	0.00316230	0.00100000	0.22186	0.45322	0.23136
40.	5	4	0.00316230	0.00031623	0.22250	0.46495	0.24245
41.	5	4	0.00316230	0.00010000	0.22287	0.47364	0.25077
42.	5	4	0.01000000	0.00316230	0.25208	0.44045	0.18837
43.	5	4	0.01000000	0.00100000	0.25334	0.45533	0.20199
44.	5	4	0.01000000	0.00031623	0.25404	0.46649	0.21245
45.	5	4	0.01000000	0.00010000	0.25442	0.47488	0.22046
46.	5	5	0.00100000	0.00031623	0.27841	0.49726	0.21885
47.	5	5	0.00100000	0.00010000	0.27841	0.49804	0.21963
48.	5	5	0.00316230	0.00100000	0.30757	0.49528	0.18771
49.	5	5	0.00316230	0.00031623	0.30759	0.49744	0.18985
50.	5	5	0.00316230	0.00010000	0.30760	0.49822	0.19062

NO.	N	NP	DELTAP	DELTAS	FP	FS	TBW
51.	5	5	0.01000000	0.00316230	0.33864	0.49215	0.15351
52.	5	5	0.01000000	0.00100000	0.33870	0.49565	0.15696
53.	5	5	0.01000000	0.00031623	0.33871	0.49765	0.15893
54.	5	5	0.01000000	0.00010000	0.33872	0.49840	0.15968
55.	7	1	0.00100000	0.00100000	0.00375	0.16493	0.16119
56.	7	1	0.00100000	0.00031623	0.00400	0.18719	0.18319
57.	7	1	0.00100000	0.00010000	0.00414	0.20846	0.20431
58.	7	1	0.00316230	0.00316230	0.00627	0.14179	0.13552
59.	7	1	0.00316230	0.00100000	0.00669	0.16497	0.15828
60.	7	1	0.00316230	0.00031623	0.00706	0.18723	0.18017
61.	7	1	0.00316230	0.00010000	0.00739	0.20850	0.20111
62.	7	1	0.01000000	0.01000000	0.01020	0.11790	0.10769
63.	7	1	0.01000000	0.00316230	0.01116	0.14192	0.13076
64.	7	1	0.01000000	0.00100000	0.01194	0.16508	0.15313
65.	7	1	0.01000000	0.00031623	0.01264	0.18735	0.17471
66.	7	1	0.01000000	0.00010000	0.01327	0.20865	0.19538
67.	7	2	0.00100000	0.00100000	0.03616	0.23047	0.19431
68.	7	2	0.00100000	0.00031623	0.03745	0.25290	0.21545
69.	7	2	0.00100000	0.00010000	0.03859	0.27367	0.23508
70.	7	2	0.00316230	0.00316230	0.04607	0.20737	0.16130
71.	7	2	0.00316230	0.00100000	0.04821	0.23133	0.18312
72.	7	2	0.00316230	0.00031623	0.04995	0.25372	0.20377
73.	7	2	0.00316230	0.00010000	0.05152	0.27448	0.22296
74.	7	2	0.01000000	0.01000000	0.05806	0.18348	0.12543
75.	7	2	0.01000000	0.00316230	0.06141	0.20905	0.14764
76.	7	2	0.01000000	0.00100000	0.06422	0.23295	0.16873
77.	7	2	0.01000000	0.00031623	0.06661	0.25521	0.18860
78.	7	2	0.01000000	0.00010000	0.06858	0.27586	0.20728
79.	7	3	0.00100000	0.00100000	0.08755	0.29269	0.20514
80.	7	3	0.00100000	0.00031623	0.08967	0.31415	0.22448
81.	7	3	0.00100000	0.00010000	0.09145	0.33345	0.24200
82.	7	3	0.00316230	0.00316230	0.10275	0.27135	0.16860
83.	7	3	0.00316230	0.00100000	0.10587	0.29483	0.18896
84.	7	3	0.00316230	0.00031623	0.10843	0.31607	0.20763
85.	7	3	0.00316230	0.00010000	0.11051	0.33520	0.22469
86.	7	3	0.01000000	0.01000000	0.11947	0.24923	0.12976
87.	7	3	0.01000000	0.00316230	0.12414	0.27478	0.15063
88.	7	3	0.01000000	0.00100000	0.12791	0.29790	0.16999
89.	7	3	0.01000000	0.00031623	0.13097	0.31885	0.18788
90.	7	3	0.01000000	0.00010000	0.13343	0.33772	0.20429
91.	7	4	0.00100000	0.00100000	0.14612	0.35387	0.20775
92.	7	4	0.00100000	0.00031623	0.14825	0.37302	0.22477
93.	7	4	0.00100000	0.00010000	0.14990	0.38977	0.23987
94.	7	4	0.00316230	0.00316230	0.16483	0.33516	0.17033
95.	7	4	0.00316230	0.00100000	0.16802	0.35666	0.18864
96.	7	4	0.00316230	0.00031623	0.17045	0.37539	0.20494
97.	7	4	0.00316230	0.00010000	0.17232	0.39189	0.21958
98.	7	4	0.01000000	0.01000000	0.18465	0.31535	0.13070
99.	7	4	0.01000000	0.00316230	0.18941	0.33934	0.14993
100.	7	4	0.01000000	0.00100000	0.19304	0.36032	0.16728

NO.	N	NP	DELTAP	DELTAS	FP	FS	TBW
101.	7	4	0.01000000	0.00031623	0.19582	0.37865	0.18284
102.	7	4	0.01000000	0.00010000	0.19789	0.39460	0.19671
103.	7	5	0.00100000	0.00031623	0.20883	0.42763	0.21881
104.	7	5	0.00100000	0.00010000	0.20977	0.44023	0.23047
105.	7	5	0.00316230	0.00100000	0.23097	0.41503	0.18406
106.	7	5	0.00316230	0.00031623	0.23257	0.42978	0.19721
107.	7	5	0.00316230	0.00010000	0.23370	0.44205	0.20834
108.	7	5	0.01000000	0.00316230	0.25449	0.40114	0.14665
109.	7	5	0.01000000	0.00100000	0.25707	0.41824	0.16118
110.	7	5	0.01000000	0.00031623	0.25882	0.43247	0.17365
111.	7	5	0.01000000	0.00010000	0.26005	0.44423	0.18418
112.	7	6	0.00100000	0.00031623	0.27002	0.47288	0.20285
113.	7	6	0.00100000	0.00010000	0.27032	0.47974	0.20942
114.	7	6	0.00316230	0.00100000	0.29358	0.46540	0.17182
115.	7	6	0.00316230	0.00031623	0.29413	0.47412	0.17999
116.	7	6	0.00316230	0.00010000	0.29444	0.48053	0.18609
117.	7	6	0.01000000	0.00316230	0.31831	0.45640	0.13809
118.	7	6	0.01000000	0.00100000	0.31932	0.46734	0.14801
119.	7	6	0.01000000	0.00031623	0.31991	0.47550	0.15559
120.	7	6	0.01000000	0.00010000	0.32023	0.48168	0.16145
121.	7	7	0.00100000	0.00031623	0.33507	0.49796	0.16289
122.	7	7	0.00100000	0.00010000	0.33508	0.49855	0.16347
123.	7	7	0.00316230	0.00100000	0.35825	0.49653	0.13828
124.	7	7	0.00316230	0.00031623	0.35826	0.49812	0.13985
125.	7	7	0.00316230	0.00010000	0.35827	0.49868	0.14042
126.	7	7	0.01000000	0.00316230	0.38224	0.49427	0.11203
127.	7	7	0.01000000	0.00100000	0.38229	0.49683	0.11454
128.	7	7	0.01000000	0.00031623	0.38230	0.49828	0.11598
129.	7	7	0.01000000	0.00010000	0.38231	0.49884	0.11653
130.	10	1	0.00100000	0.00100000	0.00268	0.11819	0.11551
131.	10	1	0.00100000	0.00031623	0.00289	0.13507	0.13218
132.	10	1	0.00100000	0.00010000	0.00301	0.15161	0.14861
133.	10	1	0.00316230	0.00316230	0.00446	0.10097	0.09651
134.	10	1	0.00316230	0.00100000	0.00479	0.11822	0.11343
135.	10	1	0.00316230	0.00031623	0.00509	0.13510	0.13001
136.	10	1	0.00316230	0.00010000	0.00536	0.15164	0.14628
137.	10	1	0.01000000	0.01000000	0.00723	0.08351	0.07628
138.	10	1	0.01000000	0.00316230	0.00794	0.10107	0.09313
139.	10	1	0.01000000	0.00100000	0.00855	0.11831	0.10976
140.	10	1	0.01000000	0.00031623	0.00911	0.13520	0.12609
141.	10	1	0.01000000	0.00010000	0.00963	0.15174	0.14211
142.	10	2	0.00100000	0.00100000	0.02599	0.16605	0.14005
143.	10	2	0.00100000	0.00031623	0.02719	0.18380	0.15661
144.	10	2	0.00100000	0.00010000	0.02820	0.20089	0.17270
145.	10	2	0.00316230	0.00316230	0.03290	0.14824	0.11534
146.	10	2	0.00316230	0.00100000	0.03469	0.16675	0.13207
147.	10	2	0.00316230	0.00031623	0.03624	0.18451	0.14828
148.	10	2	0.00316230	0.00010000	0.03764	0.20153	0.16389
149.	10	2	0.00500000	0.00316230	0.03692	0.14867	0.11175
150.	10	2	0.00500000	0.00100000	0.03889	0.16715	0.12826

NO.	N	NF	DELTAP	DELTAS	FP	FS	TBW
151.	10	2	0.00500000	0.00031623	0.04066	0.18494	0.14428
152.	10	2	0.00500000	0.00010000	0.04221	0.20195	0.15974
153.	10	2	0.01000000	0.01000000	0.04121	0.13026	0.08906
154.	10	2	0.01000000	0.00316230	0.04387	0.14953	0.10566
155.	10	2	0.01000000	0.00100000	0.04624	0.16802	0.12178
156.	10	2	0.01000000	0.00031623	0.04835	0.18570	0.13735
157.	10	2	0.01000000	0.00010000	0.05019	0.20273	0.15254
158.	10	3	0.00100000	0.00100000	0.06315	0.21182	0.14867
159.	10	3	0.00100000	0.00031623	0.06536	0.22996	0.16460
160.	10	3	0.00100000	0.00010000	0.06722	0.24704	0.17983
161.	10	3	0.00316230	0.00316230	0.07352	0.19457	0.12105
162.	10	3	0.00316230	0.00100000	0.07648	0.21368	0.13721
163.	10	3	0.00316230	0.00031623	0.07907	0.23173	0.15266
164.	10	3	0.00316230	0.00010000	0.08133	0.24872	0.16740
165.	10	3	0.00500000	0.00316230	0.07934	0.19559	0.11625
166.	10	3	0.00500000	0.00100000	0.08254	0.21463	0.13209
167.	10	3	0.00500000	0.00031623	0.08531	0.23260	0.14729
168.	10	3	0.00500000	0.00010000	0.08774	0.24962	0.16188
169.	10	3	0.01000000	0.01000000	0.08489	0.17728	0.09238
170.	10	3	0.01000000	0.00316230	0.08901	0.19740	0.10839
171.	10	3	0.01000000	0.00100000	0.09258	0.21637	0.12378
172.	10	3	0.01000000	0.00031623	0.09570	0.23424	0.13855
173.	10	3	0.01000000	0.00010000	0.09846	0.25119	0.15273
174.	10	4	0.00100000	0.00100000	0.10571	0.25774	0.15203
175.	10	4	0.00100000	0.00031623	0.10844	0.27572	0.16728
176.	10	4	0.00100000	0.00010000	0.11077	0.29245	0.18169
177.	10	4	0.00316230	0.00316230	0.11825	0.24139	0.12314
178.	10	4	0.00316230	0.00100000	0.12188	0.26050	0.13862
179.	10	4	0.00316230	0.00031623	0.12502	0.27833	0.15331
180.	10	4	0.00316230	0.00010000	0.12771	0.29484	0.16713
181.	10	4	0.00500000	0.00316230	0.12515	0.24283	0.11768
182.	10	4	0.00500000	0.00100000	0.12900	0.26184	0.13284
183.	10	4	0.00500000	0.00031623	0.13231	0.27957	0.14726
184.	10	4	0.00500000	0.00010000	0.13512	0.29604	0.16092
185.	10	4	0.01000000	0.01000000	0.13145	0.22496	0.09350
186.	10	4	0.01000000	0.00316230	0.13636	0.24529	0.10892
187.	10	4	0.01000000	0.00100000	0.14053	0.26420	0.12367
188.	10	4	0.01000000	0.00031623	0.14413	0.28173	0.13760
189.	10	4	0.01000000	0.00010000	0.14722	0.29803	0.15081
190.	10	5	0.00100000	0.00100000	0.15054	0.30377	0.15323
191.	10	5	0.00100000	0.00031623	0.15342	0.32104	0.16763
192.	10	5	0.00100000	0.00010000	0.15581	0.33693	0.18112
193.	10	5	0.00316230	0.00316230	0.16458	0.28846	0.12389
194.	10	5	0.00316230	0.00100000	0.16842	0.30710	0.13868
195.	10	5	0.00316230	0.00031623	0.17165	0.32412	0.15247
196.	10	5	0.00316230	0.00010000	0.17437	0.33972	0.16535
197.	10	5	0.00500000	0.00316230	0.17212	0.29015	0.11803
198.	10	5	0.00500000	0.00100000	0.17614	0.30864	0.13251
199.	10	5	0.00500000	0.00031623	0.17952	0.32551	0.14599
200.	10	5	0.00500000	0.00010000	0.18231	0.34101	0.15870

NO.	N	NP	DELTAP	DELTAS	FP	FS	TBW
201.	10	5	0.01000000	0.01000000	0.17906	0.27296	0.09390
202.	10	5	0.01000000	0.00316230	0.18421	0.29297	0.10876
203.	10	5	0.01000000	0.00100000	0.18850	0.31123	0.12273
204.	10	5	0.01000000	0.00031623	0.19209	0.32792	0.13584
205.	10	5	0.01000000	0.00010000	0.19507	0.34314	0.14808
206.	10	6	0.00100000	0.00031623	0.19891	0.36556	0.16666
207.	10	6	0.00100000	0.00010000	0.20114	0.37987	0.17873
208.	10	6	0.00316230	0.00100000	0.21517	0.35292	0.13775
209.	10	6	0.00316230	0.00031623	0.21808	0.36866	0.15058
210.	10	6	0.00316230	0.00010000	0.22044	0.38264	0.16220
211.	10	6	0.00500000	0.00316230	0.21942	0.33715	0.11773
212.	10	6	0.00500000	0.00100000	0.22316	0.35449	0.13132
213.	10	6	0.00500000	0.00031623	0.22619	0.37005	0.14386
214.	10	6	0.00500000	0.00010000	0.22862	0.38393	0.15531
215.	10	6	0.01000000	0.00316230	0.23195	0.34005	0.10810
216.	10	6	0.01000000	0.00100000	0.23591	0.35711	0.12120
217.	10	6	0.01000000	0.00031623	0.23907	0.37235	0.13328
218.	10	6	0.01000000	0.00010000	0.24163	0.38601	0.14439
219.	10	7	0.00100000	0.00031623	0.24439	0.40834	0.16395
220.	10	7	0.00100000	0.00010000	0.24602	0.42055	0.17453
221.	10	7	0.00316230	0.00100000	0.26158	0.39745	0.13586
222.	10	7	0.00316230	0.00031623	0.26383	0.41110	0.14727
223.	10	7	0.00316230	0.00010000	0.26556	0.42285	0.15729
224.	10	7	0.00500000	0.00316230	0.26663	0.38337	0.11675
225.	10	7	0.00500000	0.00100000	0.26968	0.39886	0.12918
226.	10	7	0.00500000	0.00031623	0.27200	0.41231	0.14031
227.	10	7	0.00500000	0.00010000	0.27377	0.42401	0.15023
228.	10	7	0.01000000	0.00316230	0.27923	0.38602	0.10679
229.	10	7	0.01000000	0.00100000	0.28240	0.40116	0.11876
230.	10	7	0.01000000	0.00031623	0.28483	0.41430	0.12947
231.	10	7	0.01000000	0.00010000	0.28664	0.42571	0.13906
232.	10	8	0.00100000	0.00031623	0.28945	0.44781	0.15837
233.	10	8	0.00100000	0.00010000	0.29030	0.45689	0.16659
234.	10	8	0.00316230	0.00100000	0.30739	0.43926	0.13187
235.	10	8	0.00316230	0.00031623	0.30871	0.44984	0.14113
236.	10	8	0.00316230	0.00010000	0.30963	0.45856	0.14894
237.	10	8	0.00500000	0.00316230	0.31335	0.42777	0.11442
238.	10	8	0.00500000	0.00100000	0.31533	0.44035	0.12501
239.	10	8	0.00500000	0.00031623	0.31669	0.45076	0.13407
240.	10	8	0.00500000	0.00010000	0.31766	0.45938	0.14172
241.	10	8	0.01000000	0.00316230	0.32570	0.42986	0.10417
242.	10	8	0.01000000	0.00100000	0.32775	0.44207	0.11432
243.	10	8	0.01000000	0.00031623	0.32916	0.45220	0.12304
244.	10	8	0.01000000	0.00010000	0.33014	0.46052	0.13038
245.	10	9	0.00100000	0.00031623	0.33438	0.48056	0.14618
246.	10	9	0.00100000	0.00010000	0.33460	0.48542	0.15082
247.	10	9	0.00316230	0.00100000	0.35254	0.47531	0.12278
248.	10	9	0.00316230	0.00031623	0.35295	0.48147	0.12852
249.	10	9	0.00316230	0.00010000	0.35319	0.48620	0.13301
250.	10	9	0.01000000	0.00316230	0.37110	0.46909	0.09799

NO.	N	NP	DELTAP	DELTAS	FP	FS	TBW
251.	10	9	0.01000000	0.00100000	0.37185	0.47685	0.10500
252.	10	9	0.01000000	0.00031623	0.37229	0.48265	0.11036
253.	10	9	0.01000000	0.00010000	0.37254	0.48698	0.11445
254.	10	10	0.00100000	0.00031623	0.38182	0.49854	0.11673
255.	10	10	0.00100000	0.00010000	0.38182	0.49896	0.11714
256.	10	10	0.00316230	0.00100000	0.39906	0.49753	0.09847
257.	10	10	0.00316230	0.00031623	0.39907	0.49866	0.09959
258.	10	10	0.00316230	0.00010000	0.39907	0.49906	0.09999
259.	10	10	0.01000000	0.00316230	0.41660	0.49594	0.07934
260.	10	10	0.01000000	0.00100000	0.41663	0.49775	0.08112
261.	10	10	0.01000000	0.00031623	0.41664	0.49878	0.08214
262.	10	10	0.01000000	0.00010000	0.41665	0.49917	0.08252
263.	15	2	0.00100000	0.00031623	0.01848	0.12513	0.10665
264.	15	2	0.00100000	0.00010000	0.01928	0.13750	0.11823
265.	15	2	0.00316230	0.00100000	0.02349	0.11293	0.08944
266.	15	2	0.00316230	0.00031623	0.02465	0.12561	0.10097
267.	15	2	0.00316230	0.00010000	0.02575	0.13799	0.11224
268.	15	2	0.01000000	0.00316230	0.02959	0.10095	0.07126
269.	15	2	0.01000000	0.00100000	0.03132	0.11383	0.08251
270.	15	2	0.01000000	0.00031623	0.03290	0.12652	0.09362
271.	15	2	0.01000000	0.00010000	0.03435	0.13936	0.10452
272.	15	3	0.00100000	0.00100000	0.04282	0.14366	0.10083
273.	15	3	0.00316230	0.00316230	0.04960	0.13130	0.08169
274.	15	3	0.01000000	0.01000000	0.05704	0.11915	0.06210
275.	15	4	0.00100000	0.00100000	0.07176	0.17510	0.10335
276	15	4	0.00100000	0.00031623	0.07411	0.18877	0.11467
277.	15	4	0.00100000	0.00010000	0.07626	0.20190	0.12564
278.	15	4	0.00316230	0.00316230	0.07984	0.16310	0.08326
279.	15	4	0.00316230	0.00100000	0.08284	0.17727	0.09443
280.	15	4	0.00316230	0.00031623	0.08557	0.19087	0.10530
281.	15	4	0.00316230	0.00010000	0.08804	0.20394	0.11589
282.	15	4	0.01000000	0.01000000	0.08838	0.15130	0.06292
283.	15	4	0.01000000	0.00316230	0.09224	0.16606	0.07382
284.	15	4	0.01000000	0.00100000	0.09571	0.18018	0.08446
285.	15	4	0.01000000	0.00031623	0.09886	0.19364	0.09479
286.	15	4	0.01000000	0.00010000	0.10170	0.20657	0.10487
287.	15	5	0.00100000	0.00100000	0.10228	0.20682	0.10455
288.	15	5	0.00316230	0.00316230	0.11122	0.19518	0.08396
289.	15	5	0.01000000	0.01000000	0.12048	0.18375	0.06328
290.	15	6	0.00100000	0.00100000	0.13357	0.23873	0.10517
291.	15	6	0.00100000	0.00031623	0.13664	0.25260	0.11596
292.	15	6	0.00100000	0.00010000	0.13944	0.26574	0.12630
293.	15	6	0.00316230	0.00316230	0.14317	0.22747	0.08430
294.	15	6	0.00316230	0.00100000	0.14658	0.24199	0.09501
295.	15	6	0.00316230	0.00031623	0.15038	0.25570	0.10533
296.	15	6	0.00316230	0.00010000	0.15340	0.26870	0.11530
297.	15	6	0.01000000	0.01000000	0.15292	0.21636	0.06345
298.	15	6	0.01000000	0.00316230	0.15764	0.23161	0.07397
299.	15	6	0.01000000	0.00100000	0.16182	0.24596	0.08414
300.	15	6	0.01000000	0.00031623	0.16556	0.25946	0.09390

NO.	N	NP	DELTAP	DELTAS	FP	FS	TBW
301.	15	6	0.01000000	0.00010000	0.16891	0.27225	0.10334
302.	15	7	0.00100000	0.00100000	0.16531	0.27074	0.10542
303.	15	7	0.00316230	0.00316230	0.17538	0.25986	0.08448
304.	15	7	0.01000000	0.01000000	0.18552	0.24906	0.06353
305.	15	9	0.00100000	0.00100000	0.19721	0.30278	0.10557
306.	15	9	0.00100000	0.00031623	0.20040	0.31619	0.11579
307.	15	9	0.00100000	0.00010000	0.20322	0.32865	0.12544
308.	15	8	0.00316230	0.00316230	0.20773	0.29226	0.08453
309.	15	9	0.00316230	0.00100000	0.21169	0.30645	0.09477
310.	15	9	0.00316230	0.00031623	0.21509	0.31959	0.10450
311.	15	9	0.00316230	0.00010000	0.21805	0.33184	0.11378
312.	15	9	0.01000000	0.01000000	0.21821	0.28179	0.06358
313.	15	9	0.01000000	0.00316230	0.22309	0.29681	0.07373
314.	15	9	0.01000000	0.00100000	0.22730	0.31071	0.08340
315.	15	9	0.01000000	0.00031623	0.23097	0.32358	0.09260
316.	15	9	0.01000000	0.00010000	0.23415	0.33556	0.10141
317.	15	10	0.00100000	0.00031623	0.26397	0.37854	0.11456
318.	15	10	0.00100000	0.00010000	0.26624	0.38961	0.12337
319.	15	10	0.00316230	0.00100000	0.27595	0.36988	0.09394
320.	15	10	0.00316230	0.00031623	0.27882	0.38169	0.10287
321.	15	10	0.00316230	0.00010000	0.28121	0.39247	0.11126
322.	15	10	0.01000000	0.00316230	0.28800	0.36113	0.07313
323.	15	10	0.01000000	0.00100000	0.29162	0.37381	0.08219
324.	15	10	0.01000000	0.00031623	0.29463	0.38527	0.09064
325.	15	10	0.01000000	0.00010000	0.29713	0.39570	0.09856
326.	15	13	0.00100000	0.00031623	0.35726	0.46465	0.10739
327.	15	13	0.00100000	0.00010000	0.35793	0.47086	0.11293
328.	15	13	0.00316230	0.00100000	0.37011	0.45907	0.08896
329.	15	13	0.00316230	0.00031623	0.37106	0.46620	0.09514
330.	15	13	0.00316230	0.00010000	0.37176	0.47214	0.10038
331.	15	13	0.01000000	0.00316230	0.38297	0.45293	0.06995
332.	15	13	0.01000000	0.00100000	0.38444	0.46113	0.07669
333.	15	13	0.01000000	0.00031623	0.38543	0.46795	0.08252
334.	15	13	0.01000000	0.00010000	0.38612	0.47356	0.08744
335.	31	4	0.00100000	0.00031623	0.03639	0.09277	0.05638
336.	31	4	0.00100000	0.00010000	0.03764	0.09971	0.06207
337.	31	4	0.00316230	0.00100000	0.04057	0.08682	0.04625
338.	31	4	0.00316230	0.00031623	0.04208	0.09391	0.05182
339.	31	4	0.00316230	0.00010000	0.04350	0.10085	0.05735
340.	31	4	0.01000000	0.00316230	0.04503	0.08107	0.03604
341.	31	4	0.01000000	0.00100000	0.04692	0.08835	0.04142
342.	31	4	0.01000000	0.00031623	0.04869	0.09541	0.04672
343.	31	4	0.01000000	0.00010000	0.05034	0.10232	0.05198
344.	31	6	0.00100000	0.00100000	0.06539	0.11690	0.05152
345.	31	6	0.00316230	0.00316230	0.06983	0.11099	0.04116
346.	31	6	0.01000000	0.01000000	0.07438	0.10525	0.03087
347.	31	9	0.00100000	0.00100000	0.09666	0.14852	0.05186
348.	31	8	0.00100000	0.00031623	0.09896	0.15640	0.05745
349.	31	8	0.00100000	0.00010000	0.10113	0.16402	0.06289
350.	31	8	0.00316230	0.00316230	0.10142	0.14277	0.04135

NO.	N	NP	DELTAP	DELTAS	FP	FS	TBW
351.	31	8	0.00316230	0.00100000	0.10410	0.15088	0.04679
352.	31	8	0.00316230	0.00031623	0.10661	0.15870	0.05209
353.	31	8	0.00316230	0.00010000	0.10895	0.16625	0.05731
354.	31	8	0.01000000	0.01000000	0.10622	0.13719	0.03098
355.	31	8	0.01000000	0.00316230	0.10935	0.14558	0.03623
356.	31	8	0.01000000	0.00100000	0.11226	0.15363	0.04137
357.	31	8	0.01000000	0.00031623	0.11496	0.16137	0.04640
358.	31	8	0.01000000	0.00010000	0.11751	0.16887	0.05136
359.	31	10	0.00100000	0.00100000	0.12830	0.18031	0.05201
360.	31	10	0.00316230	0.00316230	0.13326	0.17469	0.04143
361.	31	10	0.01000000	0.01000000	0.13820	0.16922	0.03102
362.	31	12	0.00100000	0.00100000	0.16010	0.21221	0.05211
363.	31	12	0.00100000	0.00031623	0.16285	0.22036	0.05751
364.	31	12	0.00100000	0.00010000	0.16544	0.22815	0.06272
365.	31	12	0.00316230	0.00316230	0.16522	0.20669	0.04147
366.	31	12	0.00316230	0.00100000	0.16836	0.21512	0.04676
367.	31	12	0.00316230	0.00031623	0.17126	0.22318	0.05193
368.	31	12	0.00316230	0.00010000	0.17395	0.23092	0.05697
369.	31	12	0.01000000	0.01000000	0.17027	0.20130	0.03103
370.	31	12	0.01000000	0.00316230	0.17387	0.21005	0.03618
371.	31	12	0.01000000	0.00100000	0.17719	0.21836	0.04116
372.	31	12	0.01000000	0.00031623	0.18026	0.22633	0.04607
373.	31	12	0.01000000	0.00010000	0.18312	0.23399	0.05086
374.	31	14	0.00100000	0.00100000	0.19201	0.24412	0.05211
375.	31	14	0.00316230	0.00316230	0.19722	0.23871	0.04149
376.	31	14	0.01000000	0.01000000	0.20236	0.23341	0.03105
377.	31	16	0.00100000	0.00100000	0.22392	0.27608	0.05215
378.	31	16	0.00100000	0.00031623	0.22677	0.28419	0.05742
379.	31	16	0.00100000	0.00010000	0.22940	0.29190	0.06251
380.	31	16	0.00316230	0.00316230	0.22925	0.27075	0.04150
381.	31	16	0.00316230	0.00100000	0.23247	0.27917	0.04670
382.	31	16	0.00316230	0.00031623	0.23544	0.28715	0.05170
383.	31	16	0.00316230	0.00010000	0.23819	0.29476	0.05658
384.	31	16	0.01000000	0.01000000	0.23447	0.26553	0.03105
385.	31	16	0.01000000	0.00316230	0.23819	0.27430	0.03611
386.	31	16	0.01000000	0.00100000	0.24157	0.28258	0.04100
387.	31	16	0.01000000	0.00031623	0.24466	0.29042	0.04576
388.	31	16	0.01000000	0.00010000	0.24751	0.29790	0.05039
389.	31	20	0.00100000	0.00031623	0.29043	0.34762	0.05719
390.	31	20	0.00100000	0.00010000	0.29281	0.35491	0.06210
391.	31	20	0.00316230	0.00100000	0.29632	0.34286	0.04654
392.	31	20	0.00316230	0.00031623	0.29905	0.35043	0.05138
393.	31	20	0.00316230	0.00010000	0.30151	0.35757	0.05607
394.	31	20	0.01000000	0.00316230	0.30219	0.33820	0.03600
395.	31	20	0.01000000	0.00100000	0.30532	0.34607	0.04075
396.	31	20	0.01000000	0.00031623	0.30814	0.35349	0.04534
397.	31	20	0.01000000	0.00010000	0.31068	0.36048	0.04980
398.	31	26	0.00100000	0.00031623	0.38463	0.44066	0.05602
399.	31	26	0.00100000	0.00010000	0.38594	0.44515	0.06021
400.	31	26	0.00316230	0.00100000	0.39092	0.43667	0.04575

NO.	N	NP	DELTAP	DELTAS	FP	FS	TBW
401.	31	25	0.00316230	0.00031623	0.39250	0.44253	0.05003
402.	31	26	0.00316230	0.00010000	0.39382	0.44781	0.05399
403.	31	26	0.01000000	0.00316230	0.39711	0.43260	0.03549
404.	31	26	0.01000000	0.00100000	0.39907	0.43888	0.03981
405.	31	26	0.01000000	0.00031623	0.40070	0.44452	0.04382
406.	31	25	0.01000000	0.00010000	0.40205	0.44964	0.04759
407.	63	8	0.00100000	0.00010000	0.05007	0.08119	0.03112
408.	63	8	0.01000000	0.00100000	0.05548	0.07593	0.02045
409.	63	8	0.01000000	0.00010000	0.05828	0.08377	0.02549
410.	63	12	0.00100000	0.00100000	0.07900	0.10472	0.02571
411.	63	12	0.01000000	0.01000000	0.08389	0.09918	0.01529
412.	63	16	0.00100000	0.00100000	0.11053	0.13628	0.02575
413.	63	16	0.00100000	0.00010000	0.11397	0.14509	0.03112
414.	63	16	0.01000000	0.01000000	0.11554	0.13084	0.01530
415.	63	16	0.01000000	0.00100000	0.11977	0.14012	0.02035
416.	63	16	0.01000000	0.00010000	0.12356	0.14879	0.02522
417.	63	20	0.00100000	0.00100000	0.14214	0.16791	0.02577
418.	63	20	0.01000000	0.01000000	0.14723	0.16253	0.01531
419.	63	24	0.00100000	0.00100000	0.17378	0.19956	0.02578
420.	63	24	0.00100000	0.00010000	0.17767	0.20872	0.03105
421.	63	24	0.01000000	0.01000000	0.17893	0.19424	0.01531
422.	63	24	0.01000000	0.00100000	0.18362	0.20391	0.02030
423.	63	24	0.01000000	0.00010000	0.18780	0.21289	0.02509
424.	63	28	0.00100000	0.00100000	0.20543	0.23122	0.02578
425.	63	28	0.01000000	0.01000000	0.21063	0.22595	0.01531
426.	63	32	0.00100000	0.00100000	0.23711	0.26289	0.02578
427.	63	32	0.00100000	0.00010000	0.24111	0.27209	0.03098
428.	63	32	0.01000000	0.01000000	0.24234	0.25766	0.01532
429.	63	32	0.01000000	0.00100000	0.24715	0.26740	0.02025
430.	63	32	0.01000000	0.00010000	0.25139	0.27636	0.02497
431.	63	40	0.00100000	0.00010000	0.30425	0.33512	0.03087
432.	63	40	0.01000000	0.00100000	0.31037	0.33057	0.02020
433.	63	40	0.01000000	0.00010000	0.31438	0.33921	0.02483
434.	63	52	0.00100000	0.00010000	0.39802	0.42859	0.03057
435.	63	52	0.01000000	0.00100000	0.40436	0.42438	0.02002
436.	63	52	0.01000000	0.00010000	0.40722	0.43162	0.02440
437.	127	15	0.01000000	0.00100000	0.05951	0.06963	0.01012
438.	127	32	0.01000000	0.00100000	0.12299	0.13308	0.01009
439.	127	48	0.01000000	0.00100000	0.18619	0.19626	0.01007
440.	127	64	0.01000000	0.00100000	0.24923	0.25928	0.01005
441.	127	80	0.01000000	0.00100000	0.31211	0.32216	0.01005
442.	127	96	0.01000000	0.00100000	0.37482	0.38484	0.01003

MISCELLANEOUS DESIGNS

443.	3	1	0.00500000	0.00010000	0.01760	0.37951	0.36191
444.	3	1	0.05000000	0.00100000	0.05355	0.32650	0.27295
445.	3	2	0.00500000	0.00010000	0.10670	0.46069	0.35399

NO.	N	NP	DELTAP	DELTAS	FP	FS	TBW
446.	3	2	0.05000000	0.00100000	0.18488	0.43415	0.24927
447.	3	3	0.00500000	0.00010000	0.22471	0.49739	0.27267
448.	3	3	0.05000000	0.00100000	0.31555	0.49404	0.17848
449.	4	1	0.00500000	0.00010000	0.01454	0.32043	0.30589
450.	4	1	0.05000000	0.00100000	0.04324	0.26646	0.22322
451.	4	2	0.00500000	0.00010000	0.08830	0.40583	0.31753
452.	4	2	0.05000000	0.00100000	0.15132	0.36824	0.21692
453.	4	3	0.00500000	0.00010000	0.18075	0.46863	0.28788
454.	4	3	0.05000000	0.00100000	0.25727	0.44951	0.19224
455.	4	4	0.00500000	0.00010000	0.28116	0.49792	0.21675
456.	4	4	0.05000000	0.00100000	0.35816	0.49542	0.13726
457.	5	1	0.00500000	0.00010000	0.01232	0.27380	0.26148
458.	5	1	0.05000000	0.00100000	0.03602	0.22274	0.18673
459.	5	2	0.00500000	0.00010000	0.07532	0.35396	0.27864
460.	5	3	0.00500000	0.00010000	0.15419	0.42230	0.26812
461.	5	3	0.05000000	0.00100000	0.21865	0.39408	0.17543
462.	5	4	0.05000000	0.00100000	0.30362	0.45922	0.15559
463.	5	5	0.00500000	0.00010000	0.31977	0.49828	0.17851
464.	5	5	0.05000000	0.00100000	0.38515	0.49629	0.11114
465.	6	1	0.00500000	0.00010000	0.01064	0.23730	0.22666
466.	6	1	0.05000000	0.00100000	0.03074	0.19044	0.15970
467.	6	2	0.00500000	0.00010000	0.06544	0.31052	0.24508
468.	6	2	0.05000000	0.00100000	0.10957	0.27080	0.16124
469.	6	3	0.00500000	0.00010000	0.13456	0.37636	0.24180
470.	6	3	0.05000000	0.00100000	0.18942	0.34498	0.15557
471.	6	4	0.00500000	0.00010000	0.20504	0.43408	0.22904
472.	6	4	0.05000000	0.00100000	0.26486	0.41154	0.14668
473.	6	5	0.00500000	0.00010000	0.27468	0.47802	0.20334
474.	6	5	0.05000000	0.00100000	0.33540	0.46582	0.13042
475.	6	6	0.00500000	0.00010000	0.34726	0.49855	0.15129
476.	6	6	0.05000000	0.00100000	0.40365	0.49689	0.09324
477.	7	7	0.05000000	0.00100000	0.41708	0.49732	0.08024
478.	8	7	0.05000000	0.00100000	0.37586	0.47421	0.09835
479.	9	7	0.05000000	0.00100000	0.34288	0.44088	0.09800
480.	10	1	0.01000000	0.00045600	0.00894	0.12990	0.12097
481.	10	2	0.01000000	0.00045600	0.04769	0.18020	0.13251
482.	10	3	0.00200000	0.00100000	0.07087	0.21283	0.14197
483.	10	3	0.01000000	0.00045600	0.09476	0.22870	0.13393
484.	10	3	0.05000000	0.00100000	0.12103	0.22218	0.10115
485.	10	3	0.05000000	0.01000000	0.11103	0.18375	0.07272
486.	10	3	0.05000000	0.06999993	0.09988	0.14718	0.04730
487.	10	3	0.09999990	0.00100000	0.13606	0.22576	0.08970
488.	10	4	0.00200000	0.00100000	0.11520	0.25932	0.14411
489.	10	4	0.01000000	0.00045600	0.14305	0.27631	0.13326
490.	10	5	0.00200000	0.00100000	0.16104	0.30568	0.14463
491.	10	5	0.01000000	0.00045600	0.19101	0.32280	0.13179
492.	10	6	0.00200000	0.00100000	0.20742	0.35148	0.14406
493.	10	6	0.01000000	0.00200000	0.23362	0.34708	0.11346
494.	10	6	0.01000000	0.00045600	0.23814	0.36771	0.12958
495.	10	6	0.02000000	0.00100000	0.24938	0.36000	0.11062

NO.	N	NP	DELTAP	DELTAS	FP	FS	TBW
496.	10	6	0.03000000	0.00100000	0.25768	0.36183	0.10415
497.	10	7	0.01000000	0.00045600	0.28412	0.41032	0.12620
498.	10	7	0.05000000	0.00100000	0.31455	0.40747	0.09292
499.	10	8	0.01000000	0.00045600	0.32875	0.44914	0.12039
500.	10	9	0.01000000	0.00045600	0.37217	0.48095	0.10878
501.	10	10	0.01000000	0.00045600	0.41664	0.49853	0.08189
502.	11	7	0.05000000	0.00100000	0.28956	0.37691	0.08694
503.	12	2	0.09999990	0.00187440	0.06729	0.13796	0.07068
504.	12	3	0.00500000	0.02714510	0.06014	0.13098	0.07075
505.	12	3	0.01000000	0.01661580	0.06929	0.14046	0.07117
506.	12	3	0.09999990	0.00187440	0.11227	0.18182	0.06956
507.	12	4	0.00500000	0.02714510	0.09688	0.16951	0.07263
508.	12	4	0.01000000	0.01661580	0.10788	0.18017	0.07228
509.	12	7	0.05000000	0.00100000	0.26855	0.34970	0.08114
510.	13	7	0.05000000	0.00100000	0.24986	0.32566	0.07580
511.	20	5	0.00500000	0.00100000	0.09079	0.15946	0.06867
512.	20	9	0.00500000	0.00100000	0.16503	0.23370	0.06867
513.	20	10	0.01000000	0.01000000	0.21367	0.26159	0.04792
514.	20	10	0.01000000	0.00316230	0.21815	0.27386	0.05571
515.	20	10	0.01000000	0.00100000	0.22214	0.28535	0.06320
516.	20	10	0.01000000	0.00031623	0.22574	0.29616	0.07042
517.	20	10	0.01000000	0.00010000	0.22897	0.30637	0.07740
518.	20	11	0.00500000	0.00100000	0.23902	0.30735	0.06832
519.	20	11	0.01000000	0.00100000	0.24678	0.30978	0.06300
520.	20	12	0.01000000	0.00100000	0.27125	0.33405	0.06280
521.	20	13	0.01000000	0.00100000	0.29558	0.35908	0.06250
522.	20	14	0.01000000	0.00100000	0.31972	0.38189	0.06217
523.	20	15	0.01000000	0.00100000	0.34361	0.40530	0.06169
524.	20	16	0.01000000	0.00100000	0.36723	0.42916	0.06094
525.	20	17	0.01000000	0.00100000	0.39044	0.45025	0.05981
526.	20	18	0.01000000	0.00100000	0.41313	0.47080	0.05766
527.	20	19	0.01000000	0.00100000	0.43533	0.48831	0.05298
528.	20	20	0.01000000	0.00100000	0.45795	0.49887	0.04091
529.	30	22	0.01000000	0.00100000	0.34768	0.38949	0.04181
530.	30	23	0.01000000	0.00100000	0.36380	0.40546	0.04166
531.	30	24	0.01000000	0.00100000	0.37982	0.42126	0.04143
532.	40	33	0.01000000	0.00100000	0.39788	0.42911	0.03124
533.	40	34	0.01000000	0.00100000	0.40987	0.44095	0.03107
534.	50	43	0.01000000	0.00100000	0.41831	0.44330	0.02499
535.	50	44	0.01000000	0.00100000	0.42790	0.45276	0.02486

APPENDIX B

Design Curves

The design curves derived from filters 1 to 442 of Appendix A are presented here. Note that on some of the graphs the vertical scale has been broken and on others it has been compressed in the upper regions as well as broken. This was done so that all of the curves having the same set of filter parameters could be presented on a single page. Since there is a specific pair of cutoff frequencies (F_p, F_s) associated with each fixed set of parameters N, N_p, δ_p and δ_s, two sets of design curves have been presented on a single page. The left vertical axis labeled $-\log_{10} F_p$ corresponds to the solid set of curves and the right vertical axis labeled $-\log_{10} F_s$ corresponds to the dashed set of curves.

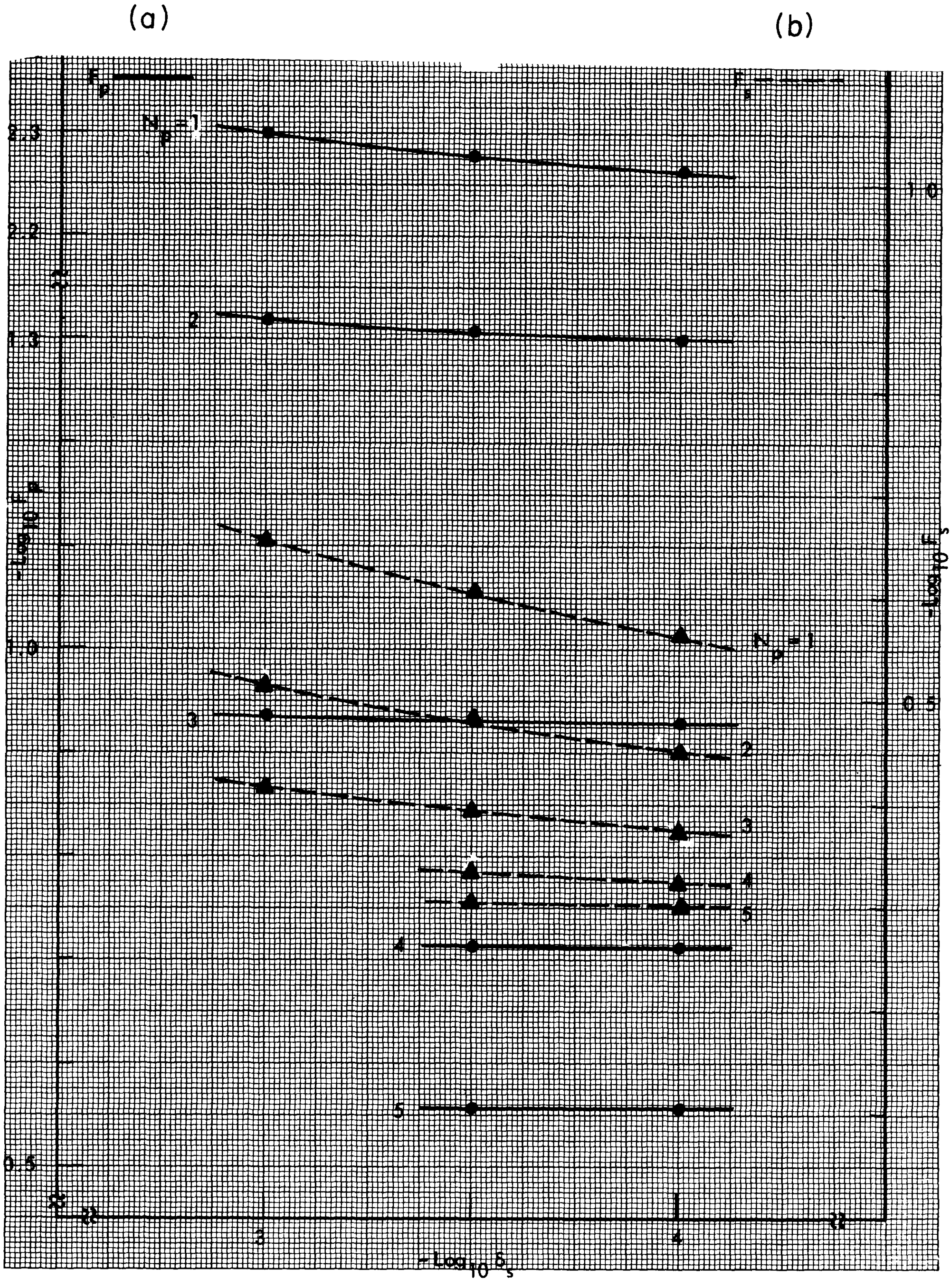


Fig. B-1. N = 5, $\delta_p = 0.001$.

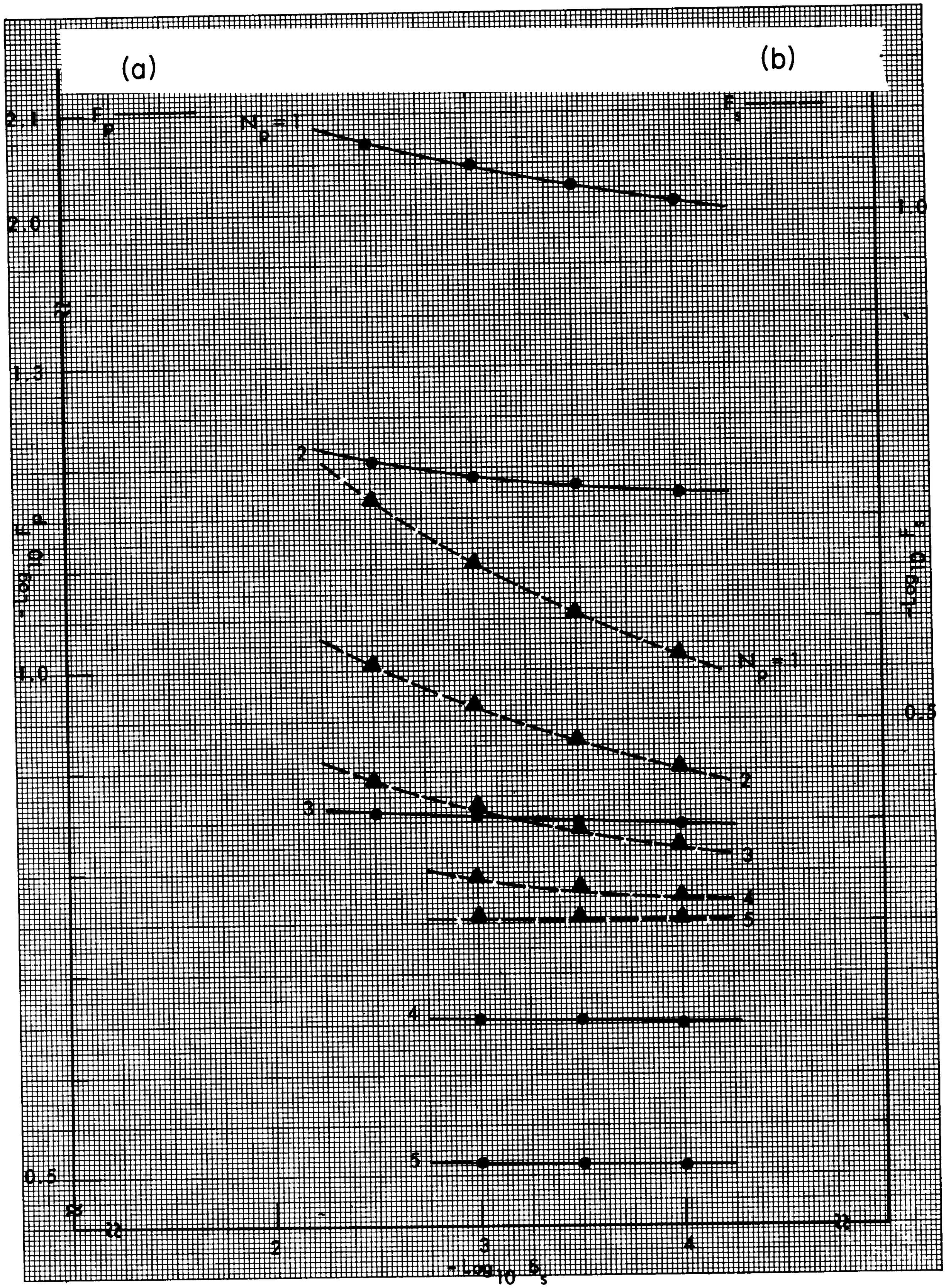


Fig. B-2. $N = 5$, $\delta_p = 0.0031623$.

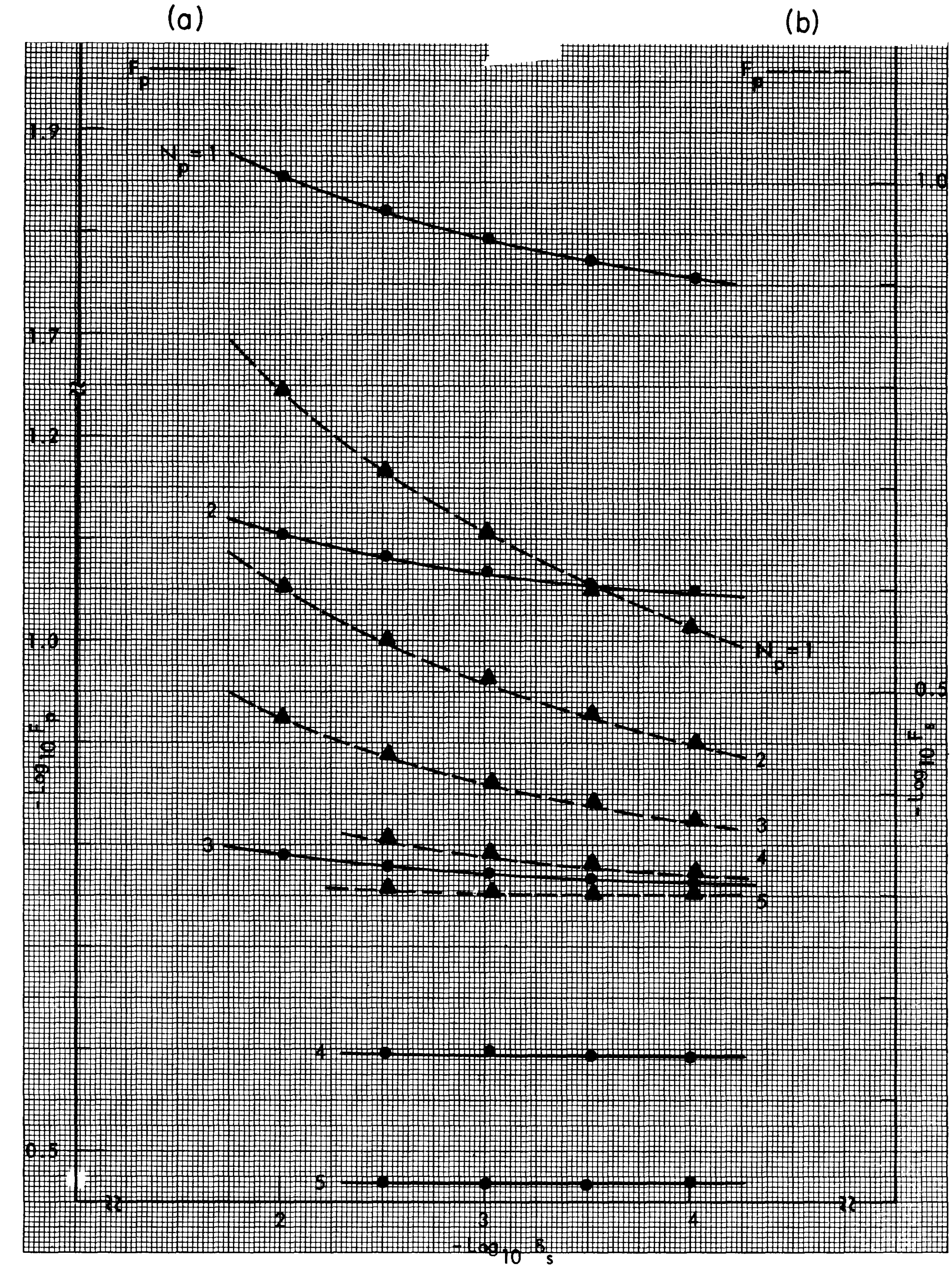


Fig. B-3. N = 5, $\delta_p = 0.01$.

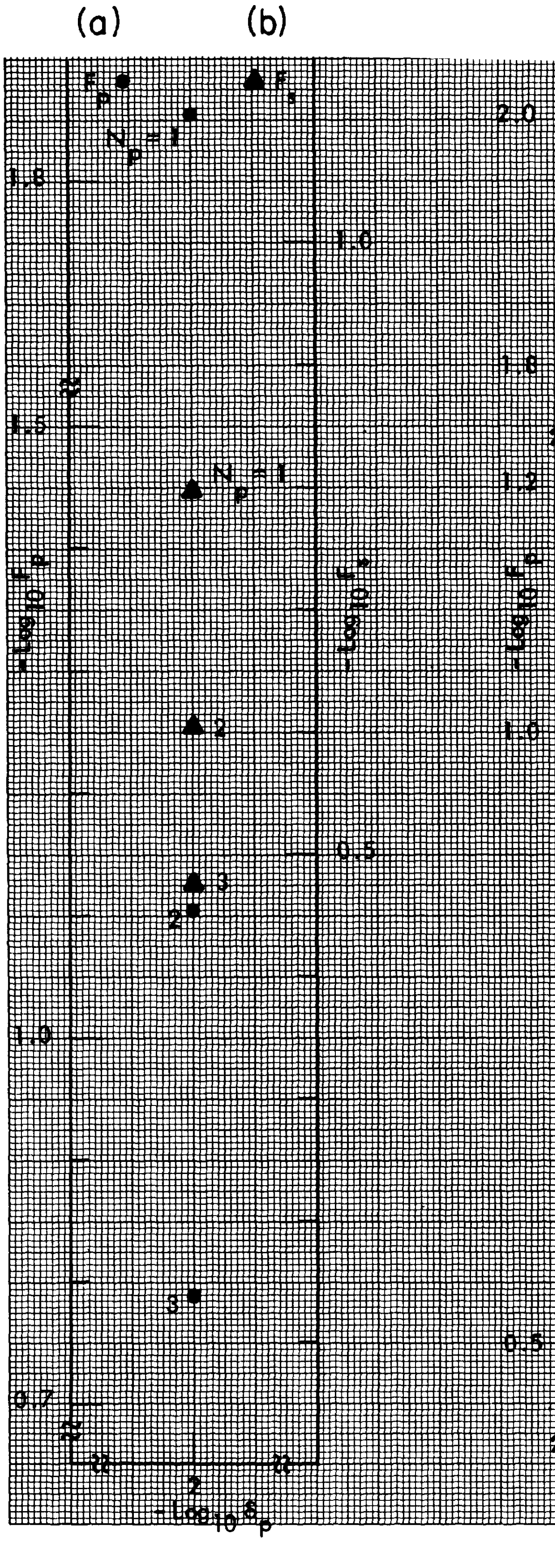


Fig. B-4. N = 5, δ_s = 0.01.

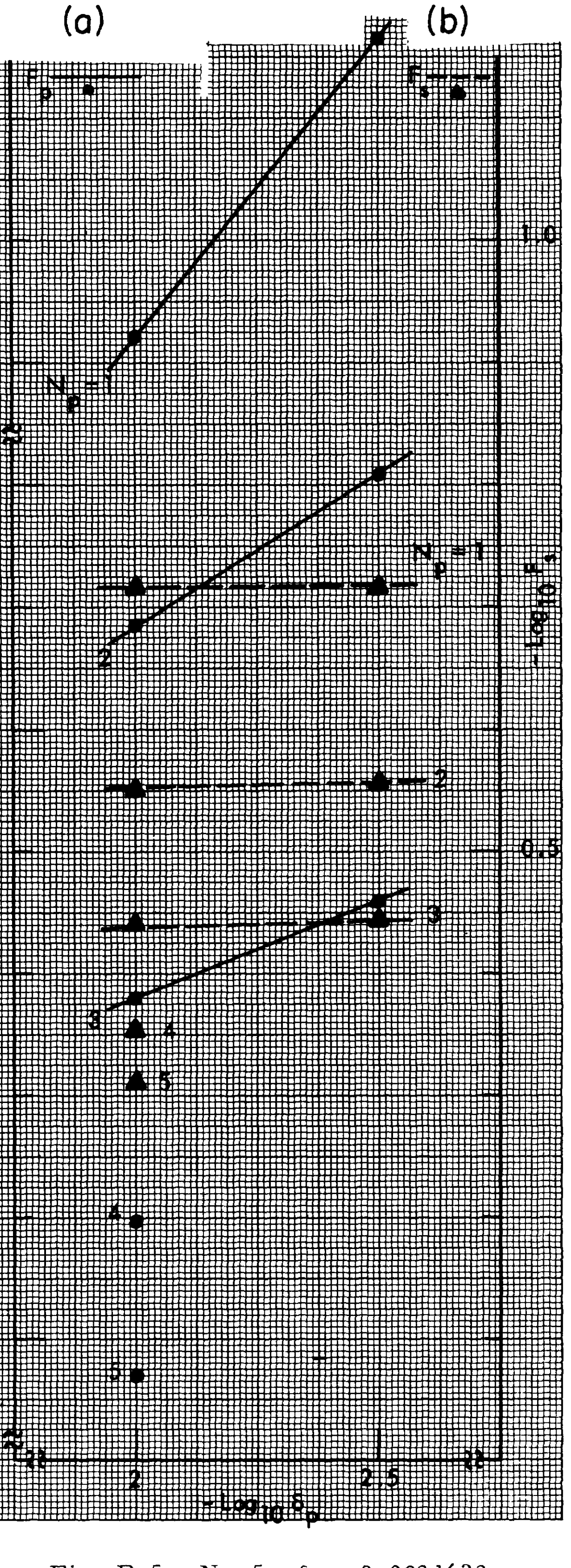


Fig. B-5. N = 5, δ_s = 0.0031623.

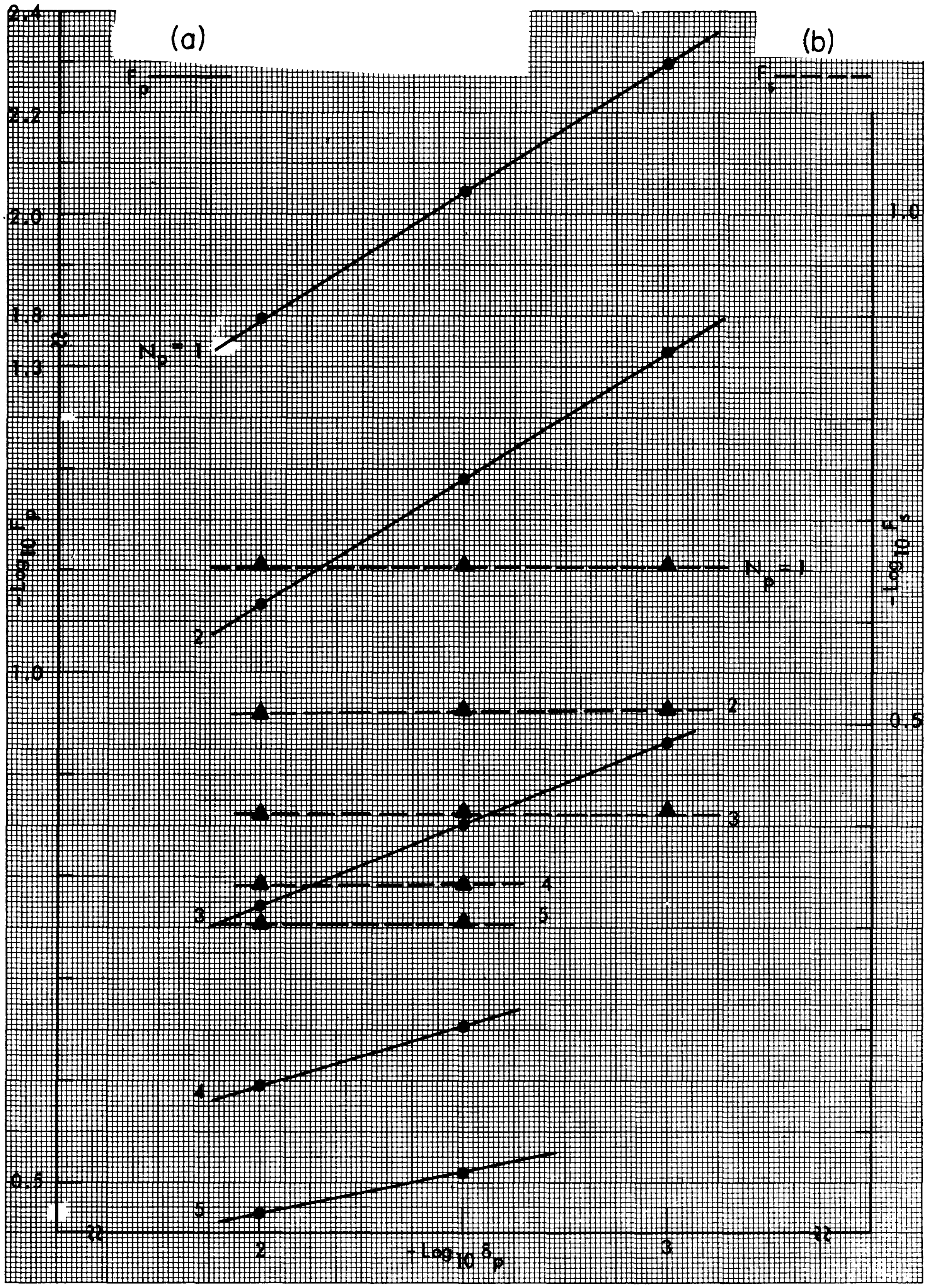


Fig. B-6. N = 5, $\delta_s = 0.001$.

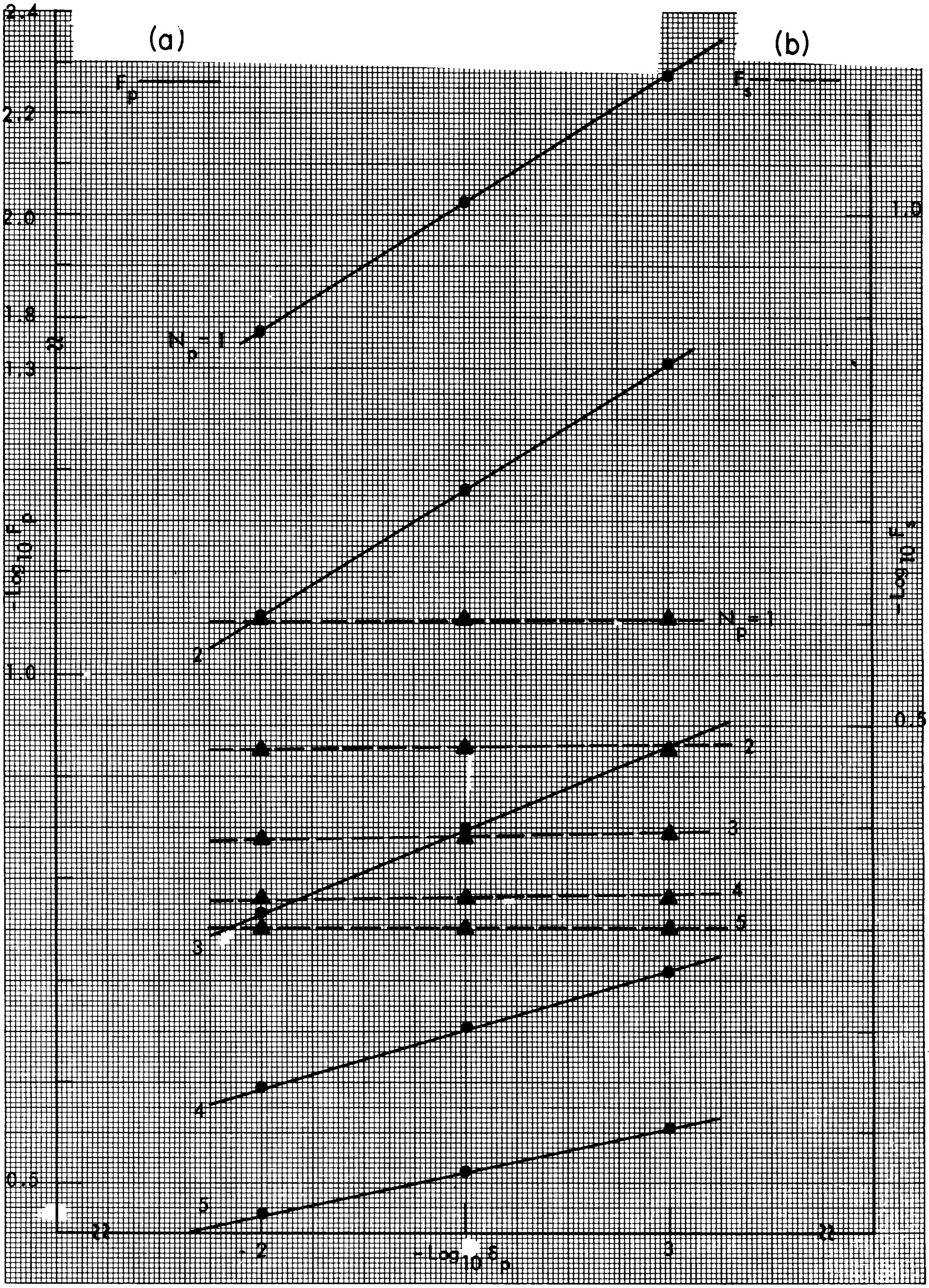


Fig. B-7. N = 5, δ_s = 0.0031623.

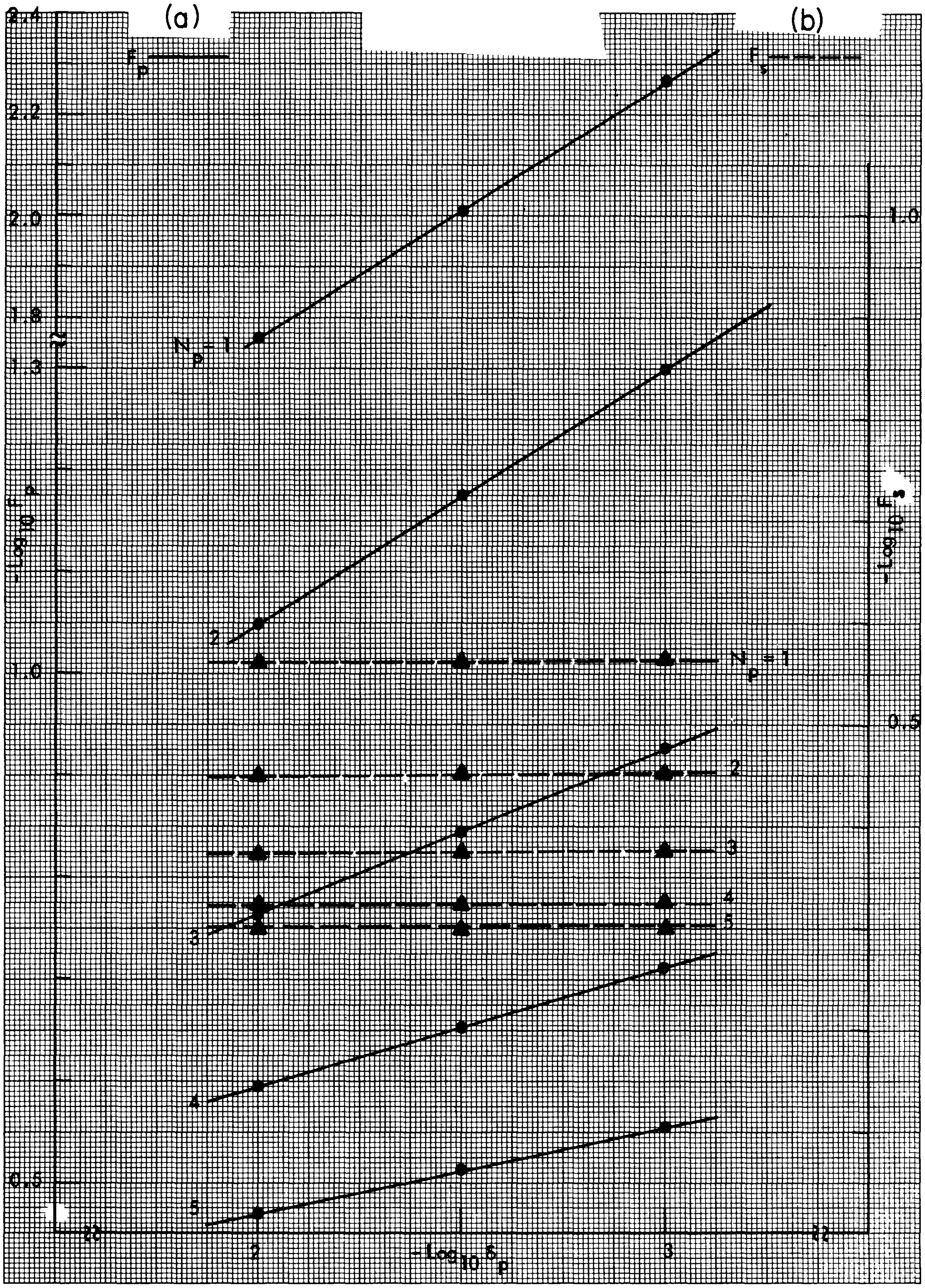


Fig. B-8. N = 5, $\delta_s = 0.0001$.

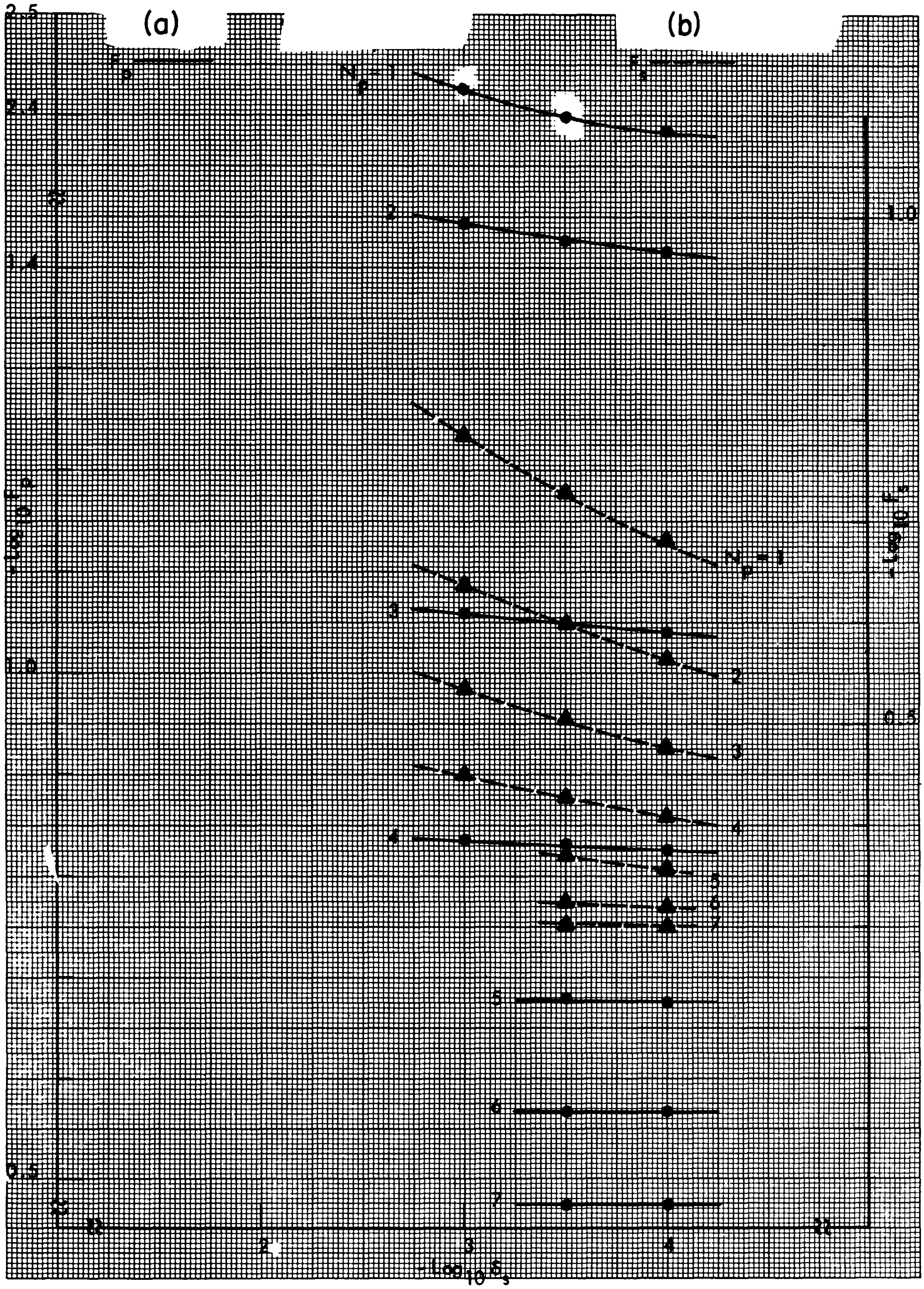


Fig. B-9. N = 7, $\delta_p = 0.001$.

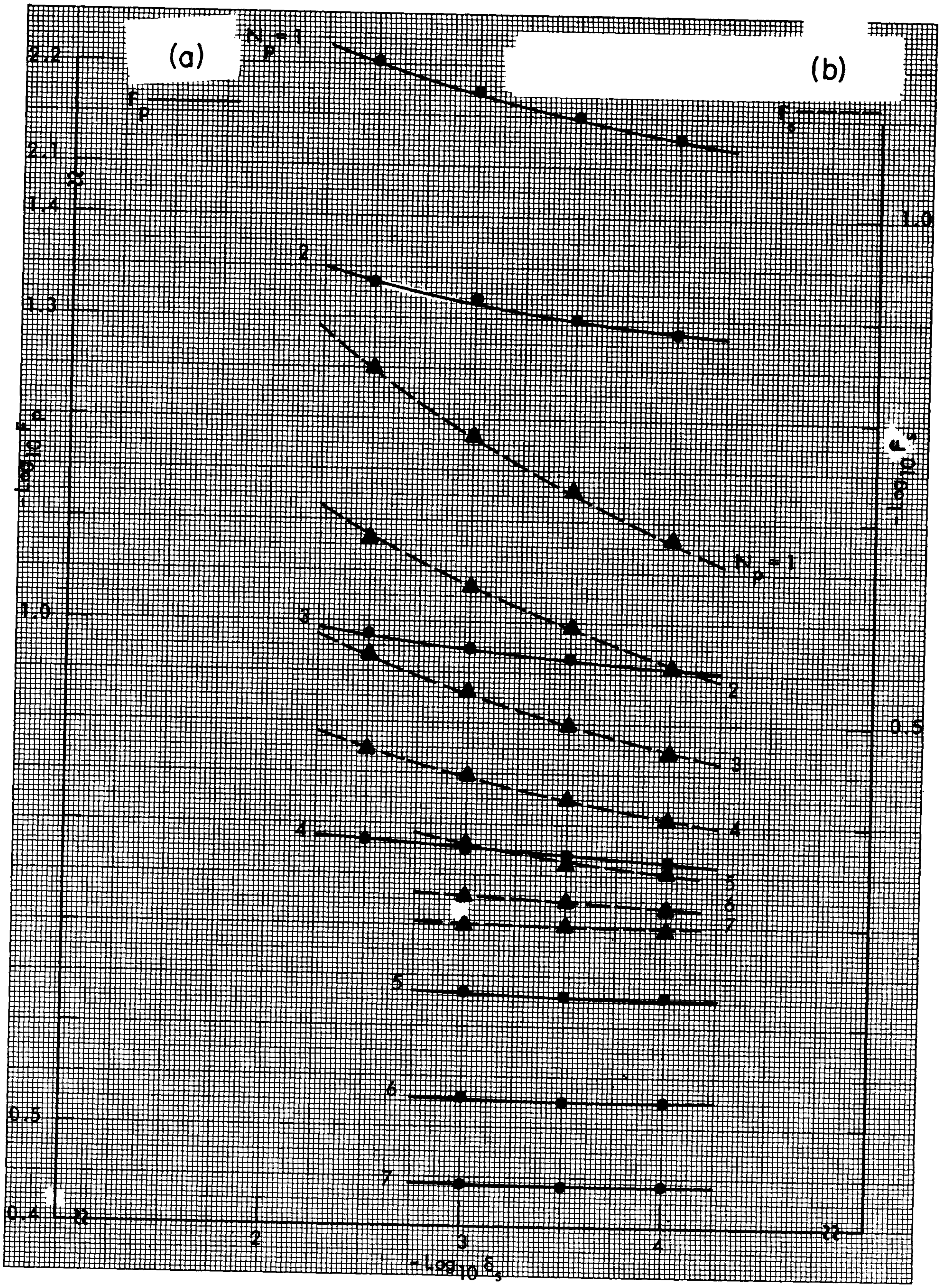


Fig. B-10. N = 7, $\delta_p = 0.0031623$.

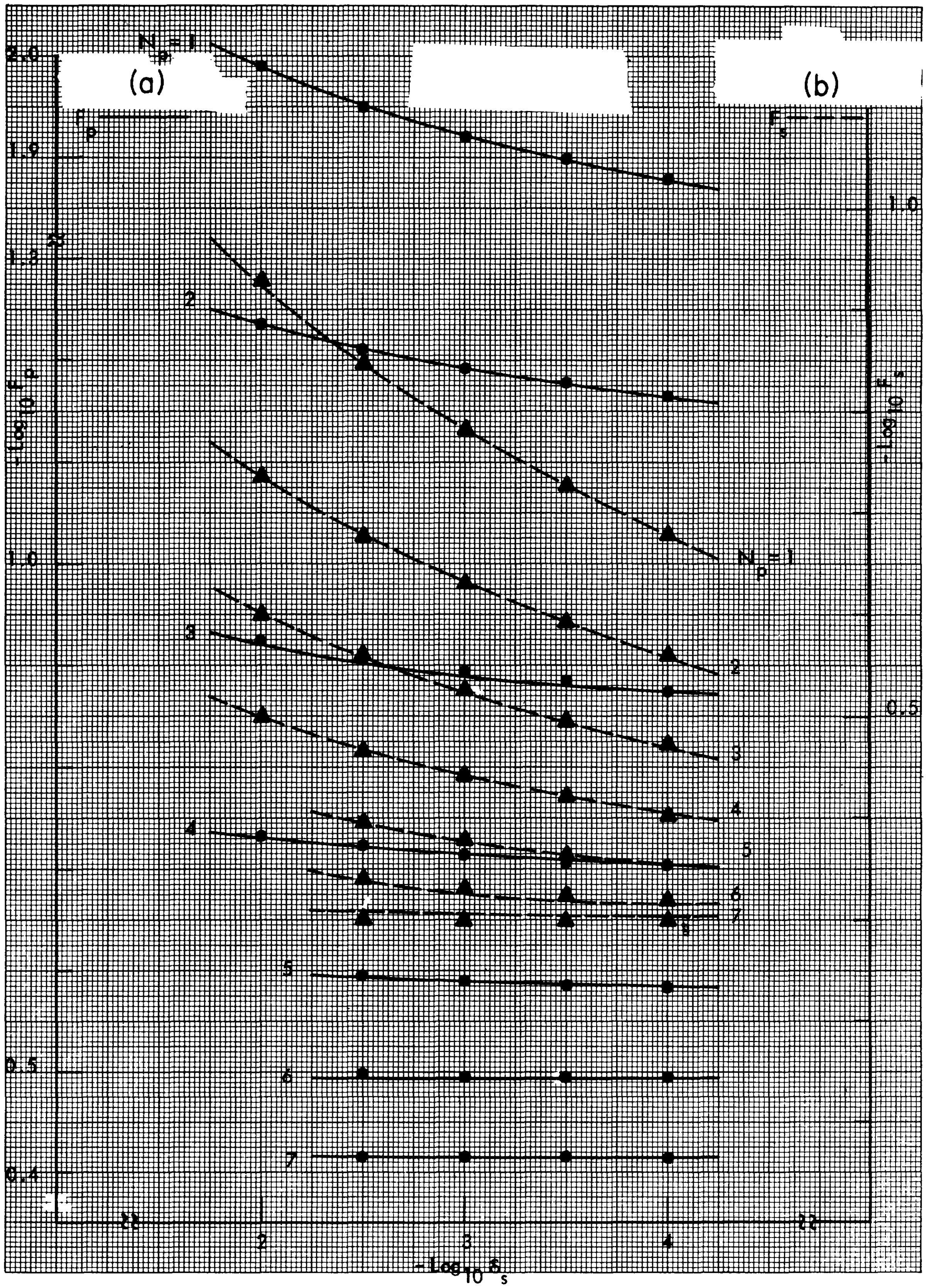


Fig. B-11. N = 7, $\delta_p = 0.01$.

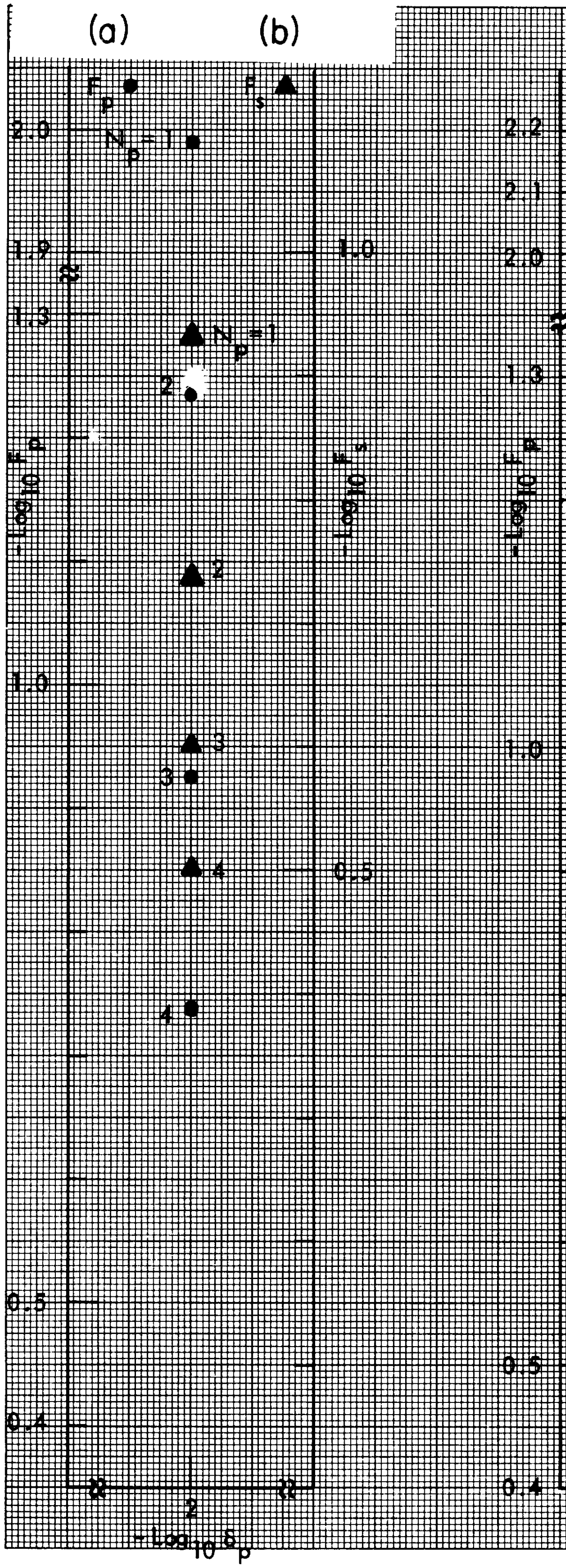


Fig. B-12. N = 7, δ_s = 0.01.

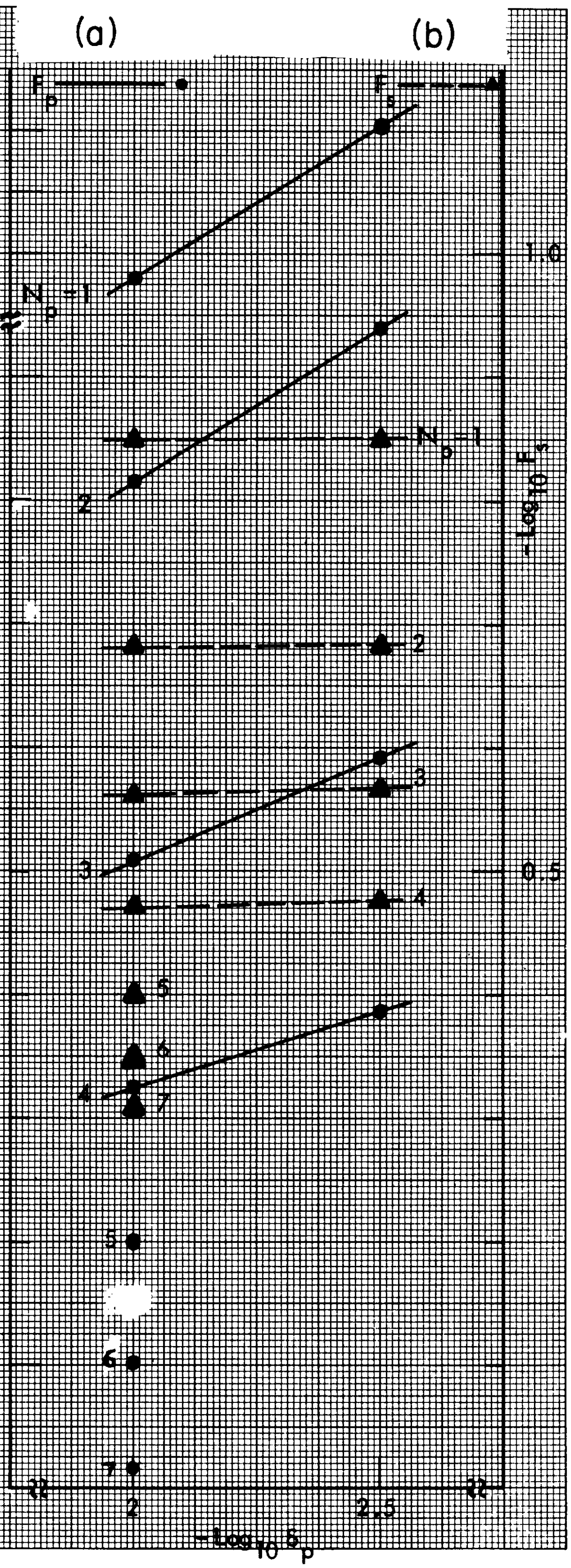


Fig. B-13. N = 7, δ_s = 0.0031623.

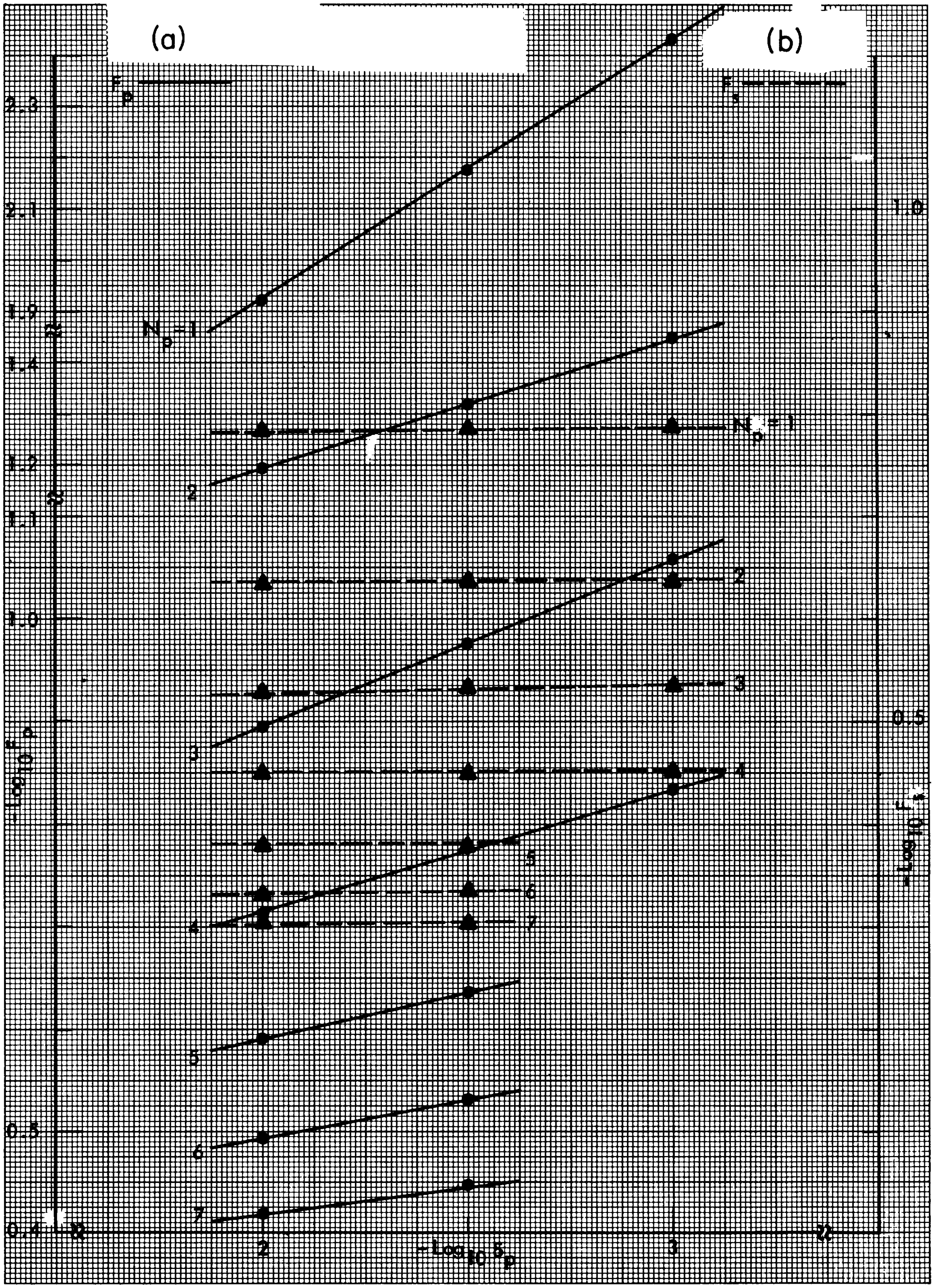


Fig. B-14. N = 7, δ_S = 0.001.

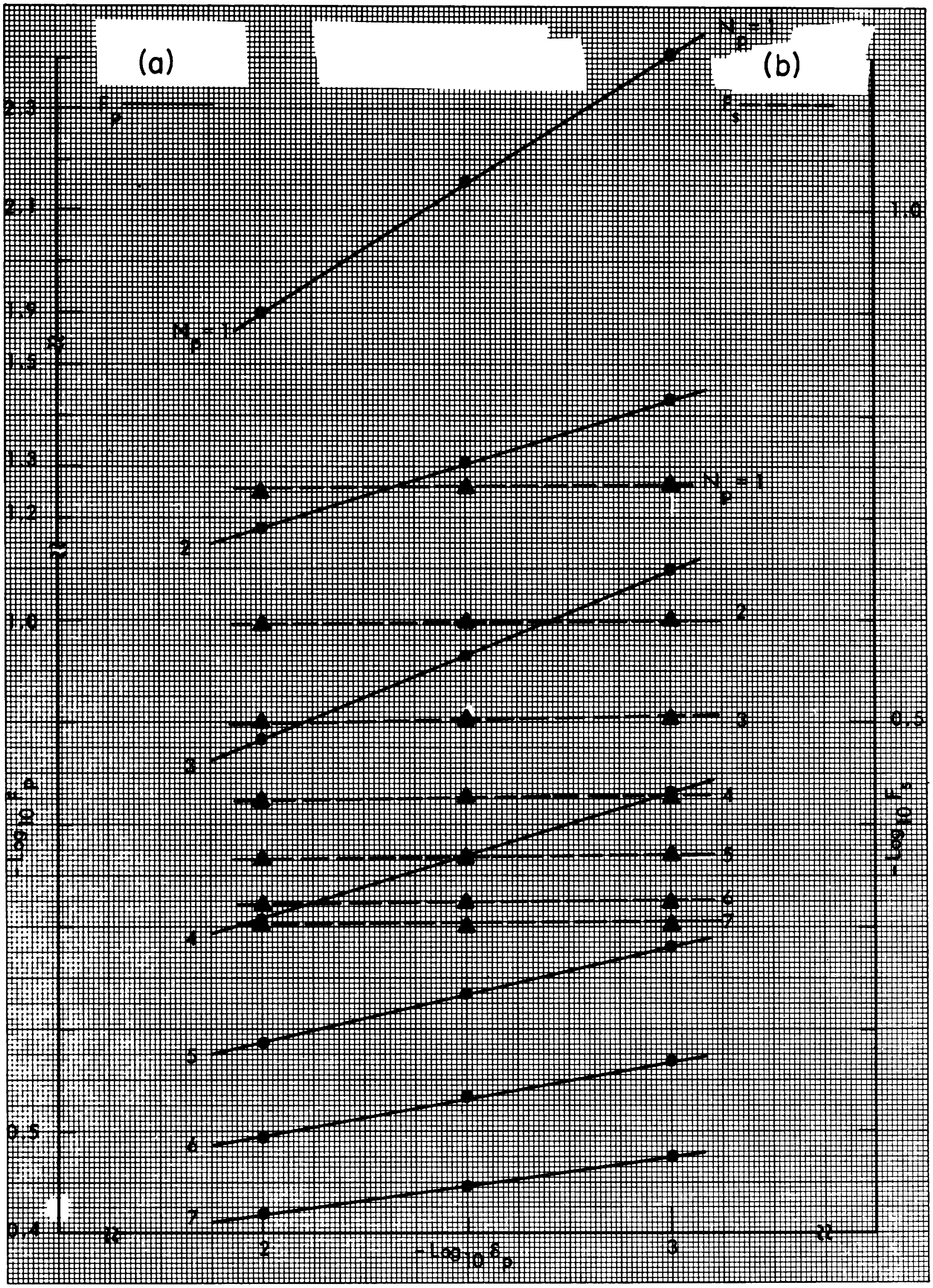


Fig. B-15. N = 7, δ_s = 0.00031623.

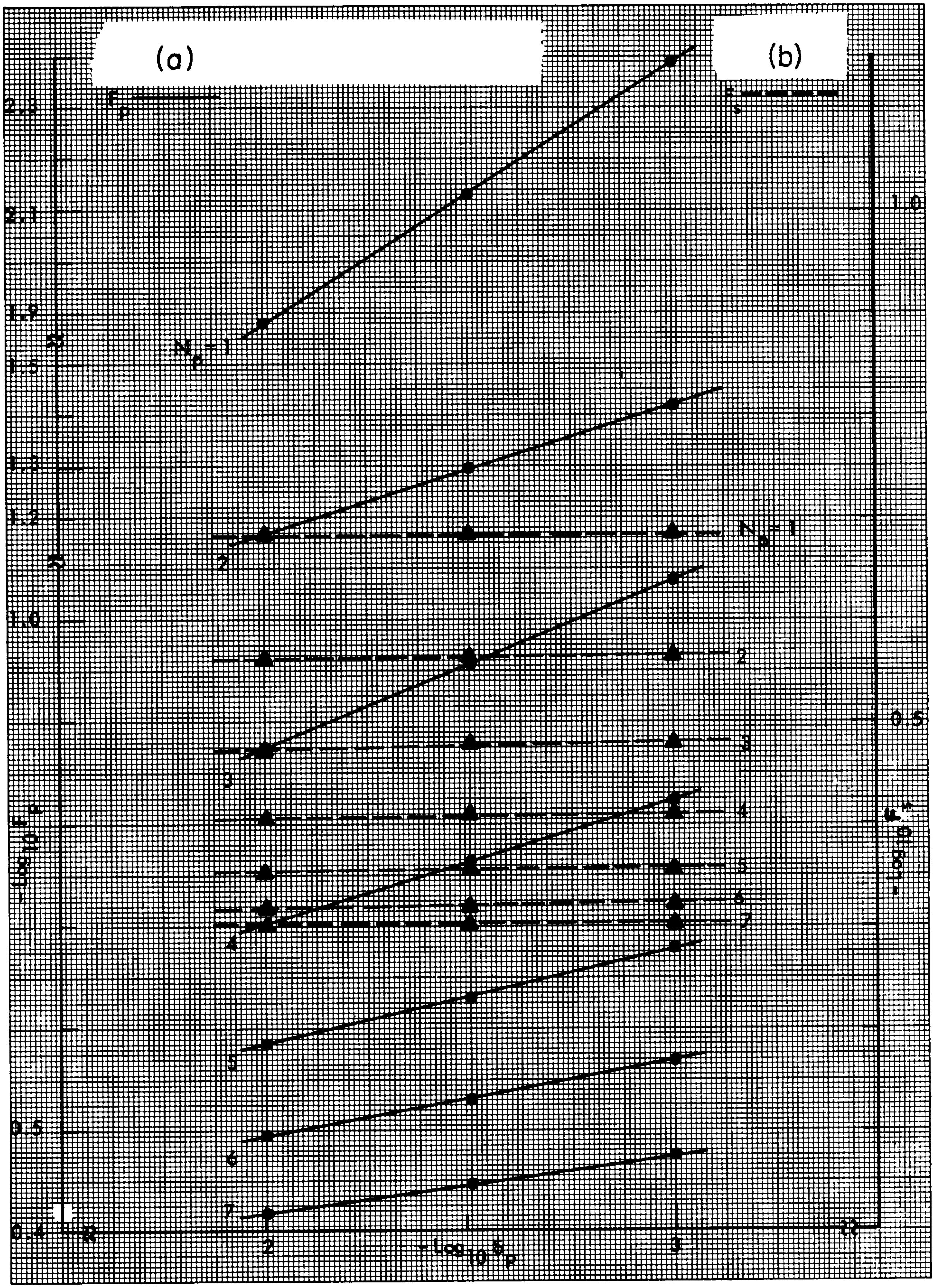


Fig. B-16. N = 7, δ_s = 0.0001.

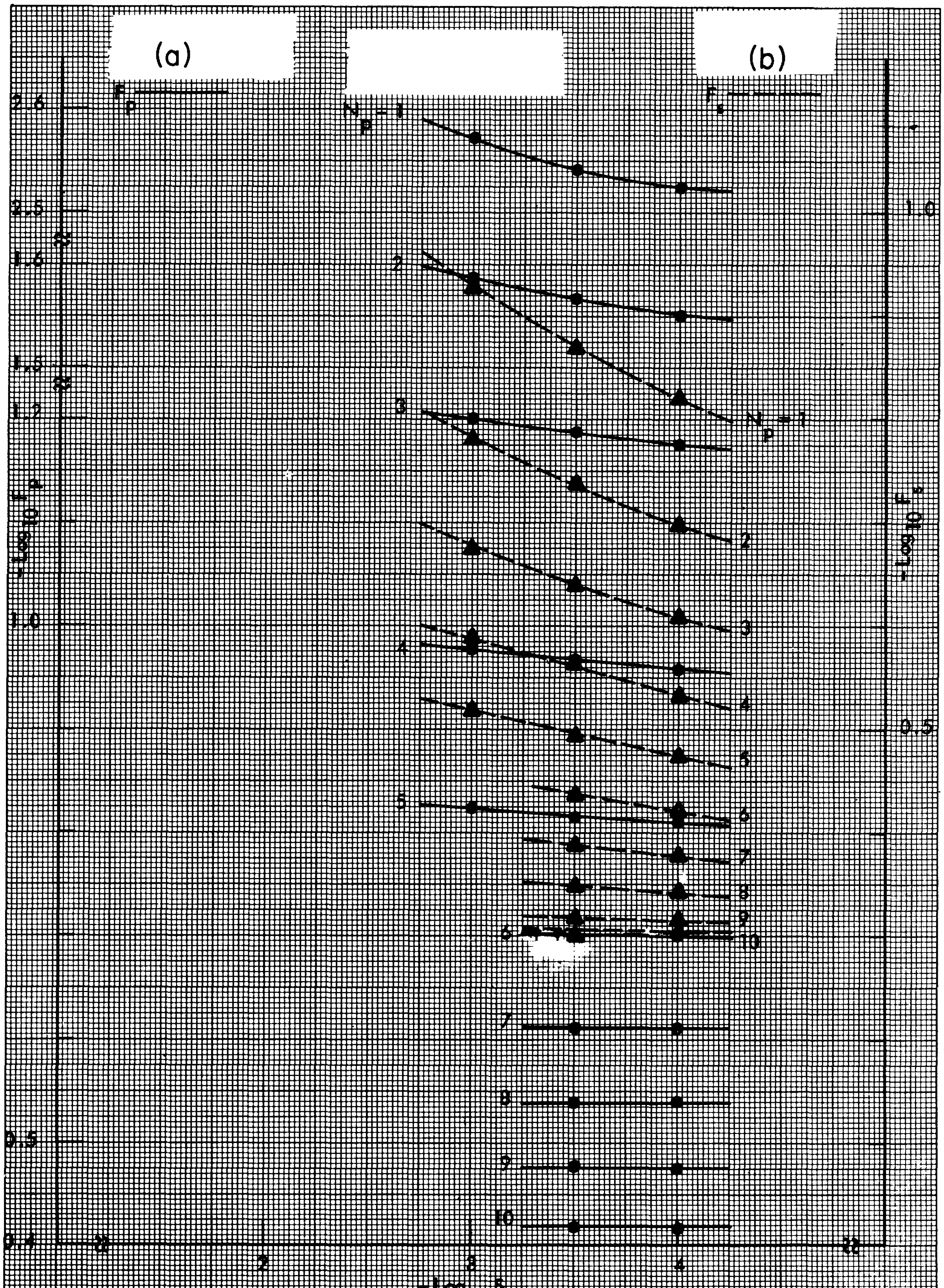


Fig. B-17. N = 10, $\delta_p = 0.001$.

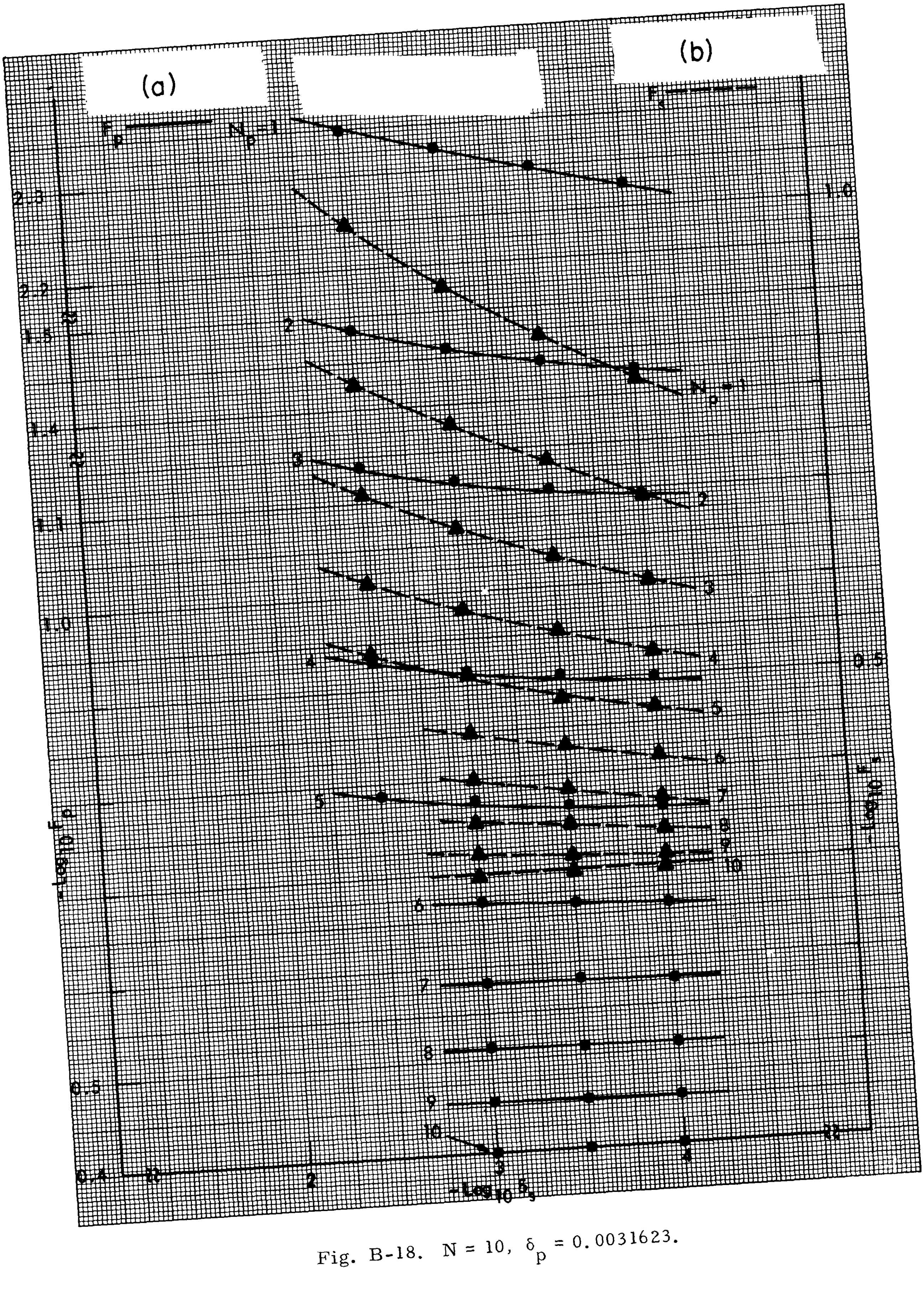


Fig. B-18. N = 10, δ_p = 0.0031623.

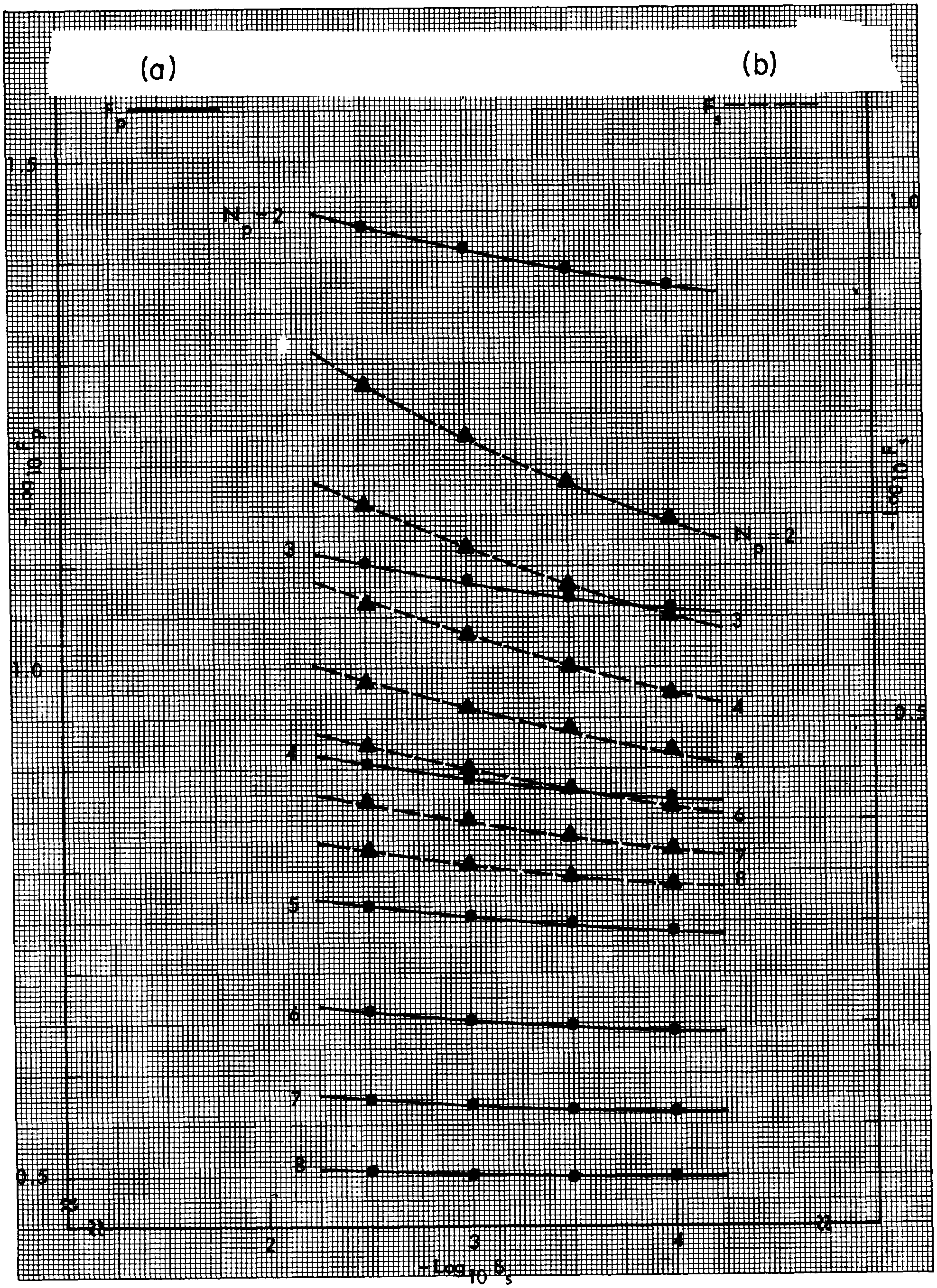


Fig. B-19. N = 10, δ_p = 0.005.

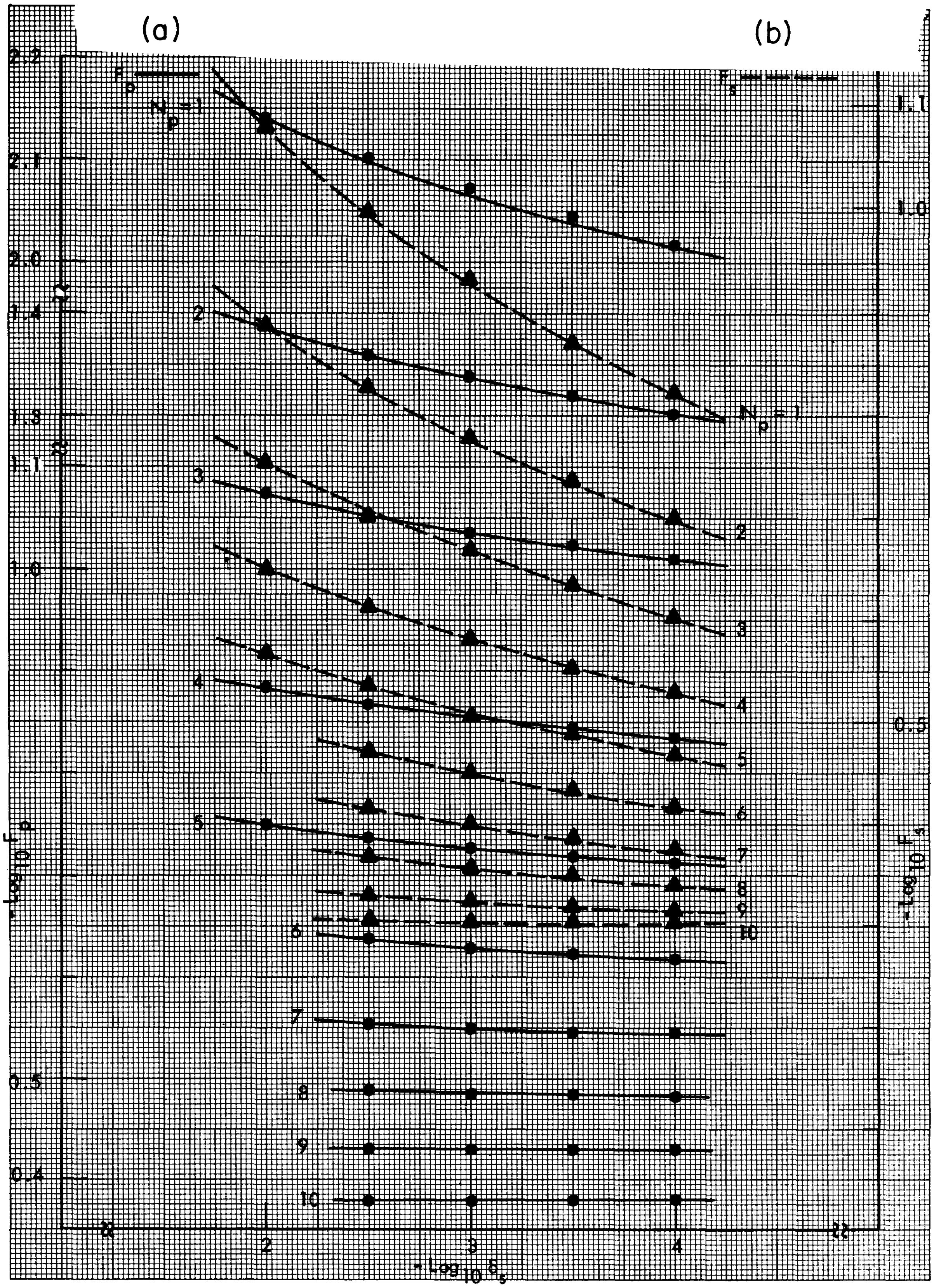


Fig. B-20. N = 10, $\delta_p = 0.01$.

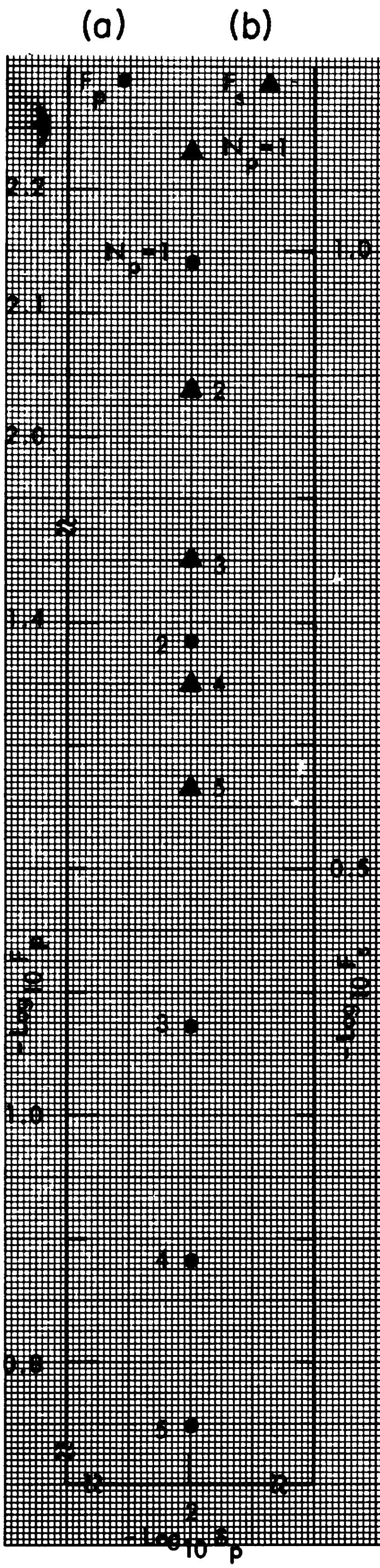


Fig. B-21. N = 10, δ_s = 0.01.

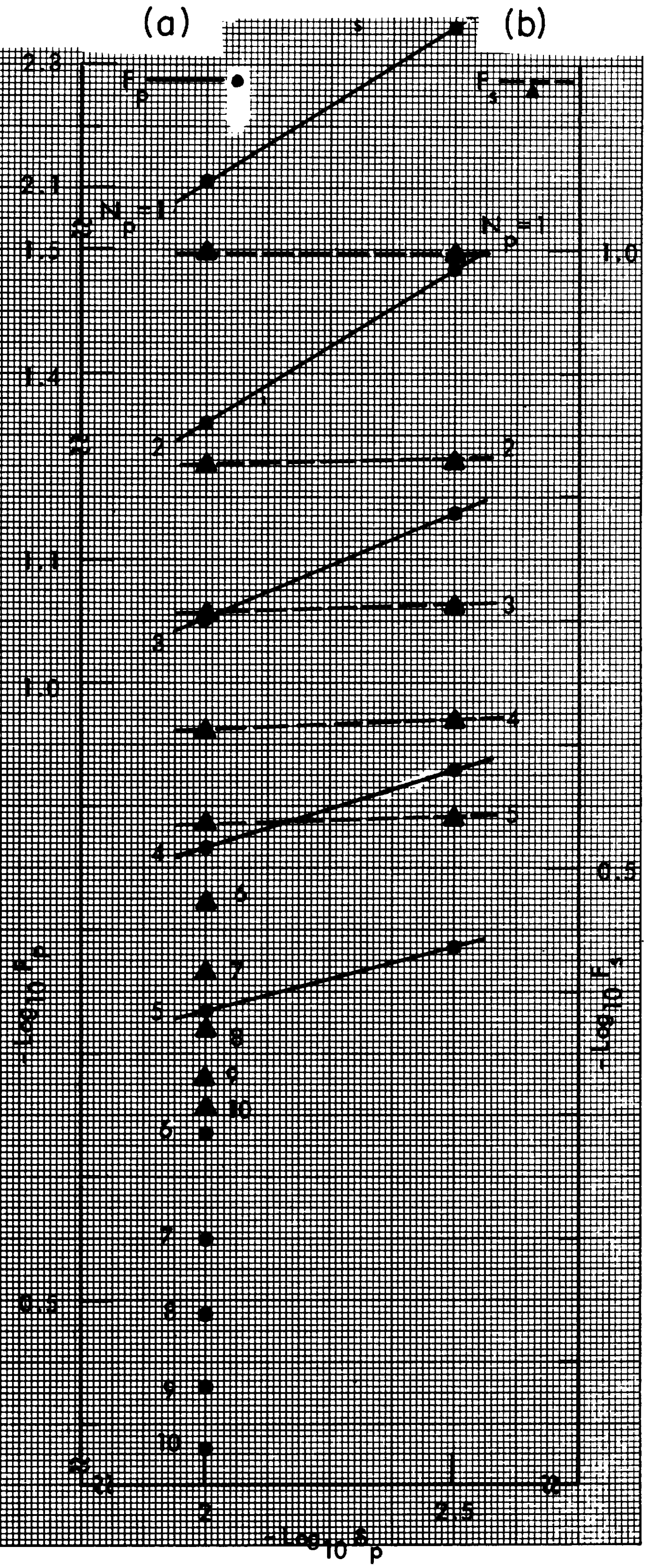


Fig. B-22. N = 10, δ_s = 0.0031623.

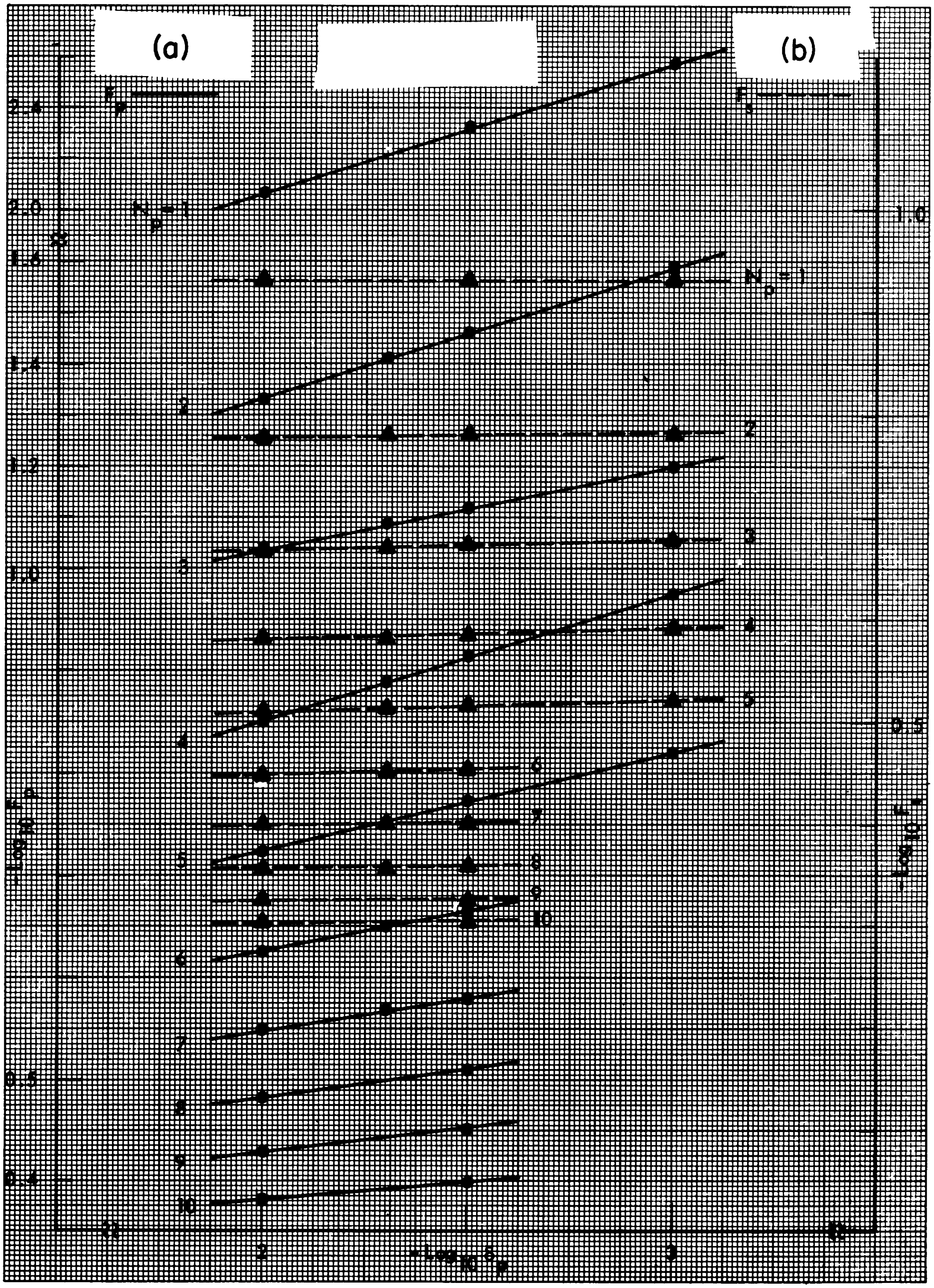


Fig. B-23. N = 10, $\delta_s = 0.001$.

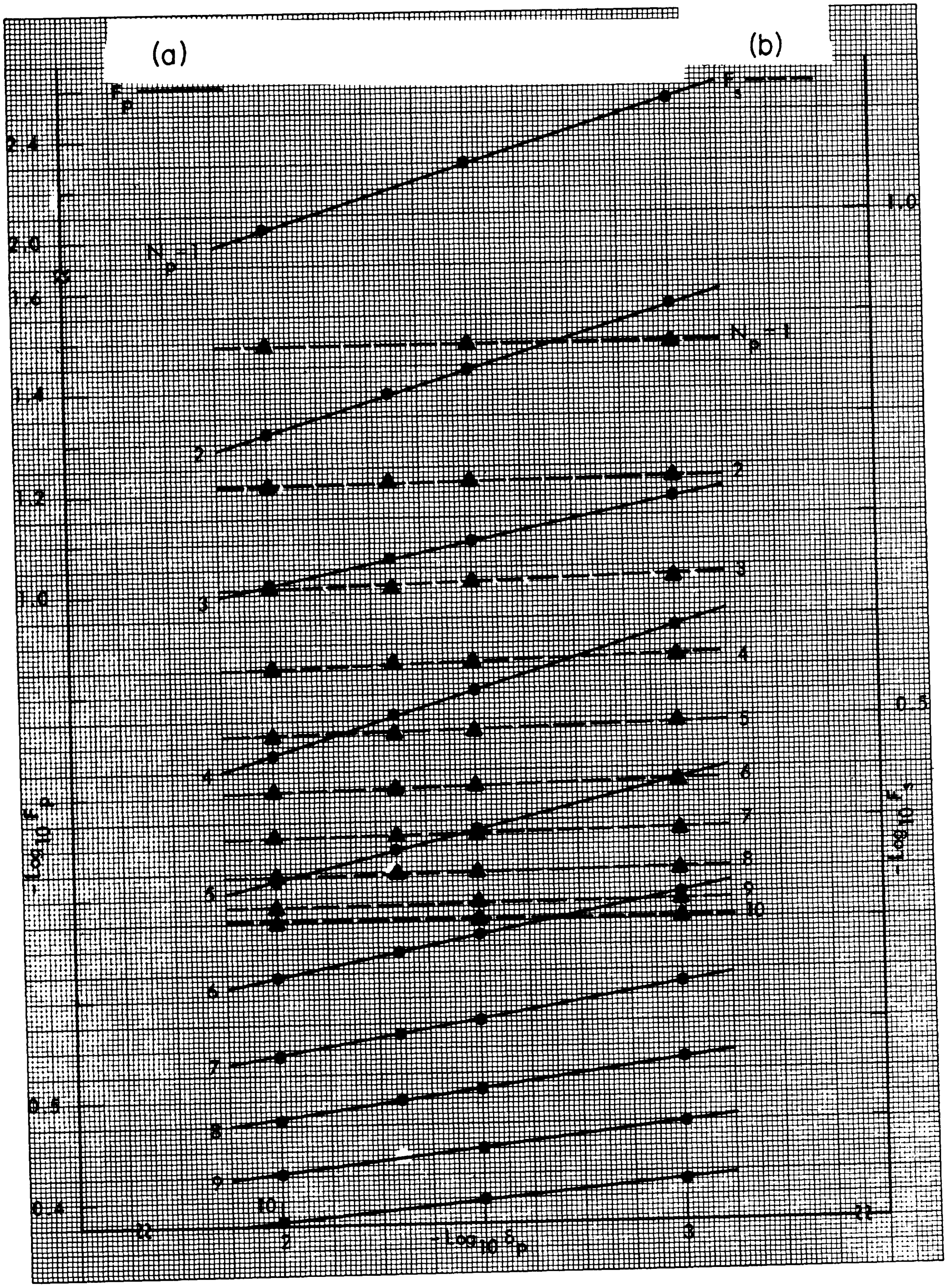


Fig. B-24. N = 10, δ_s = 0.00031623.

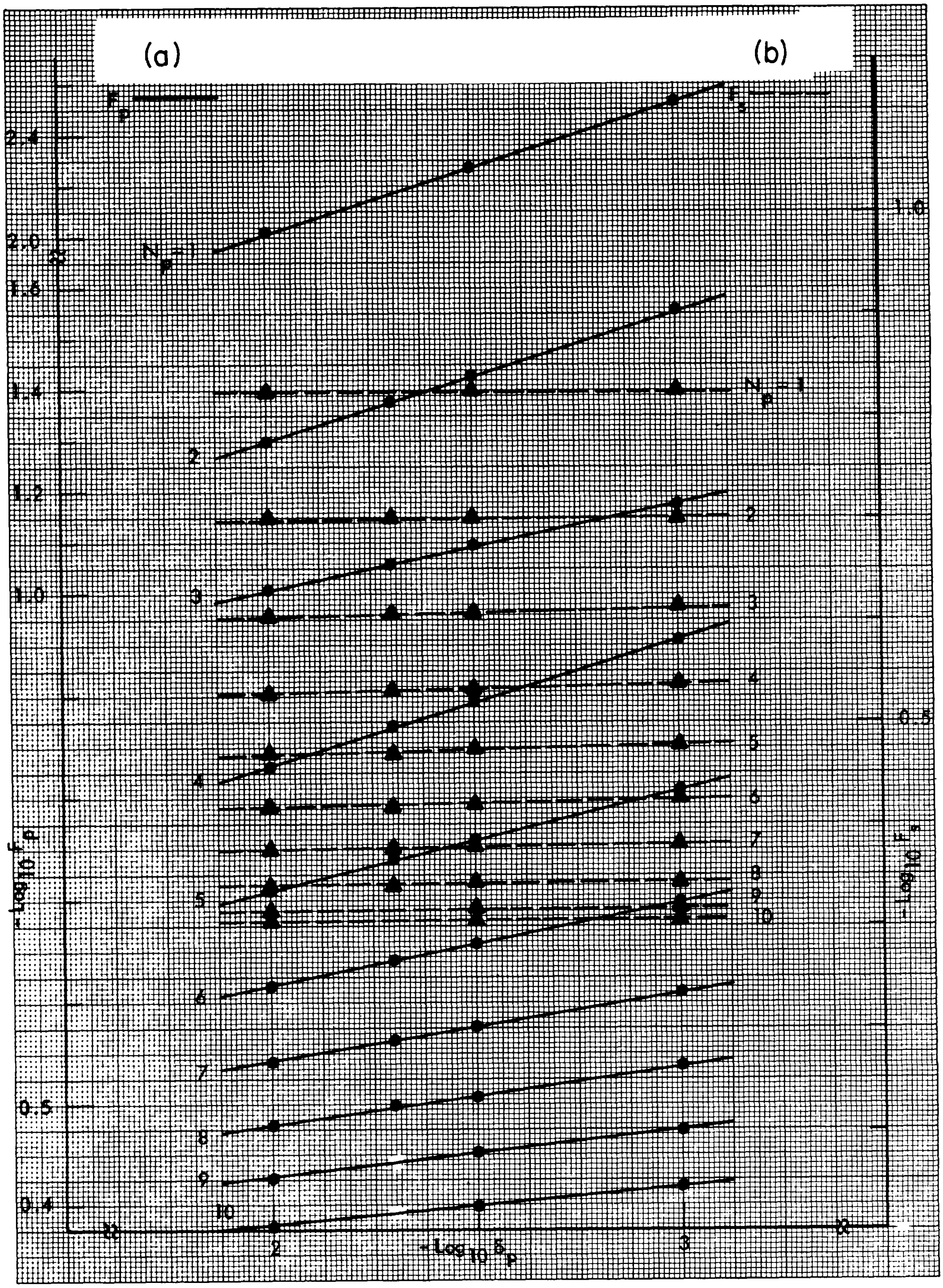


Fig. B-25. N = 10, $\delta_s = 0.0001$.

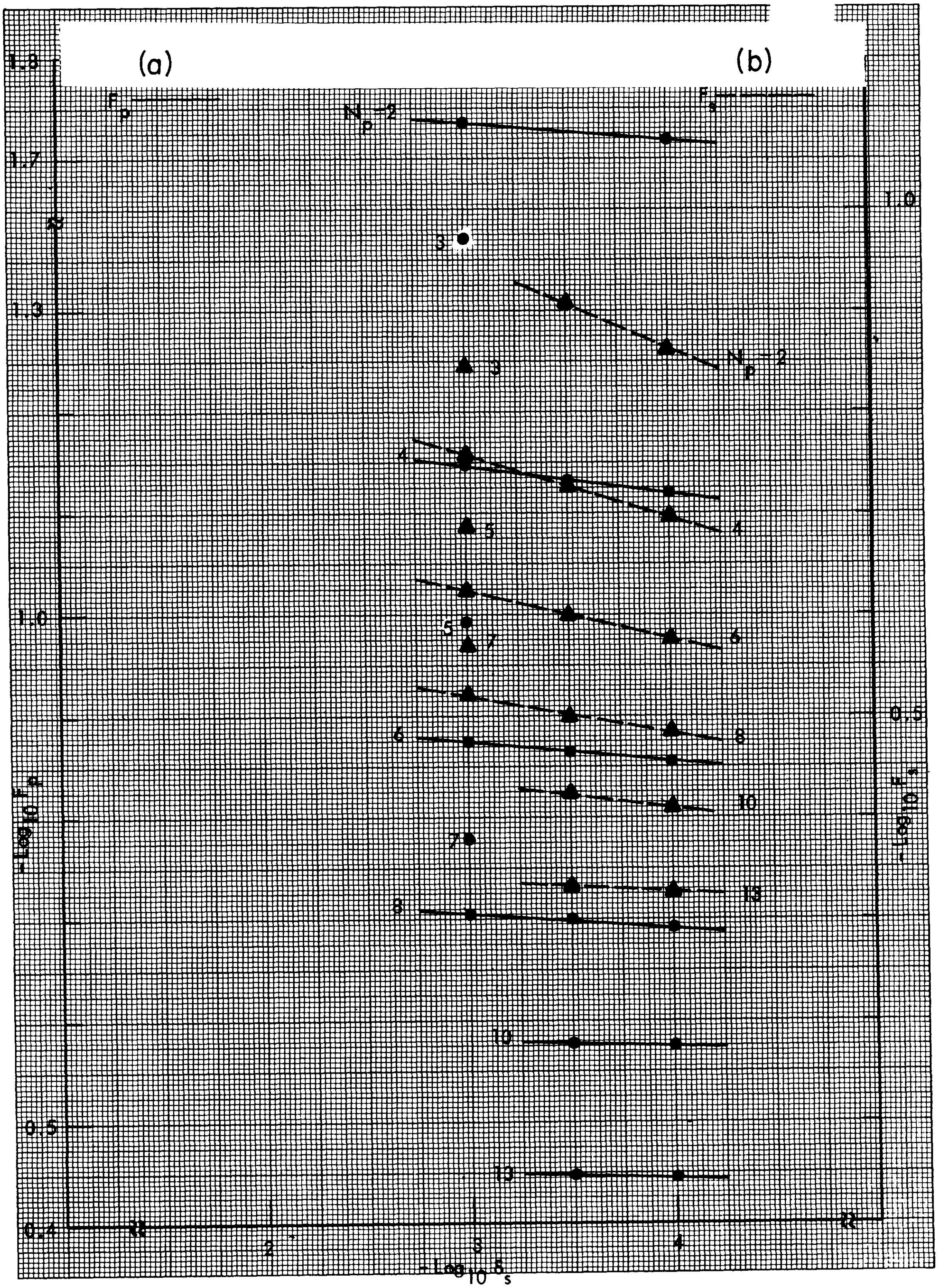


Fig. B-26. N = 15, $\delta_p = 0.001$.

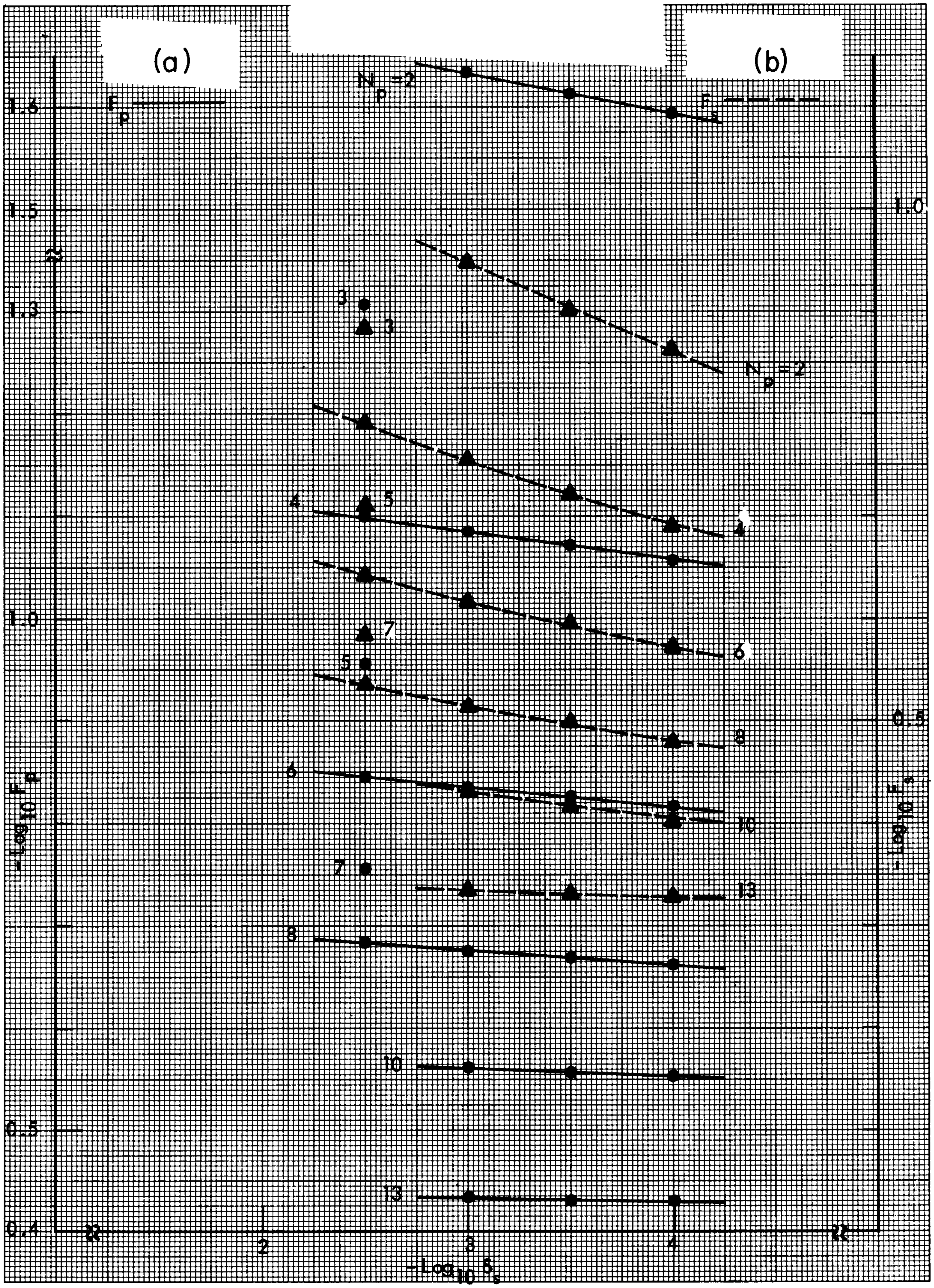


Fig. B-27. N = 15, $\delta_p = 0.0031623$.

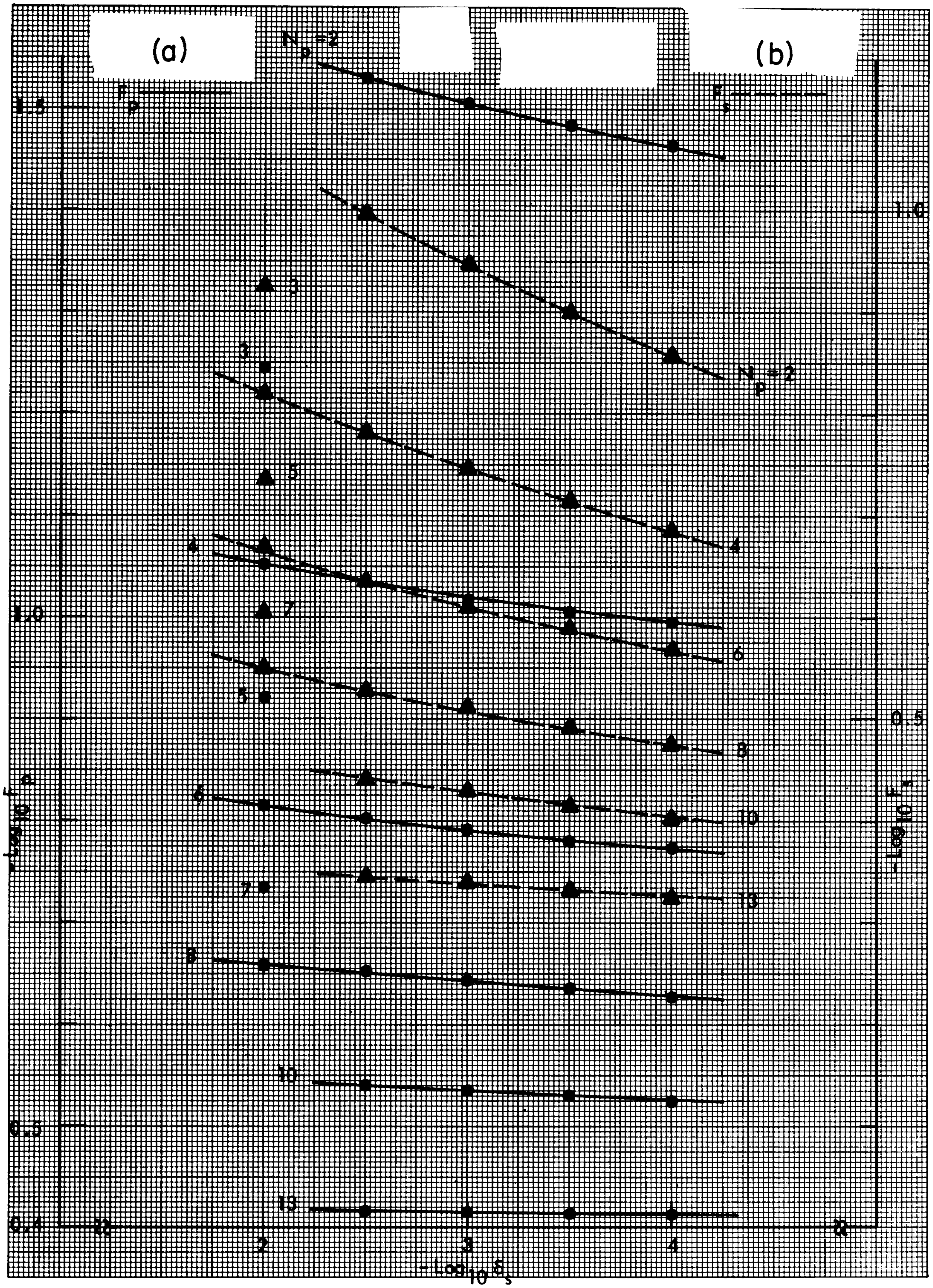


Fig. B-28. N = 15, $\delta_p = 0.01$.

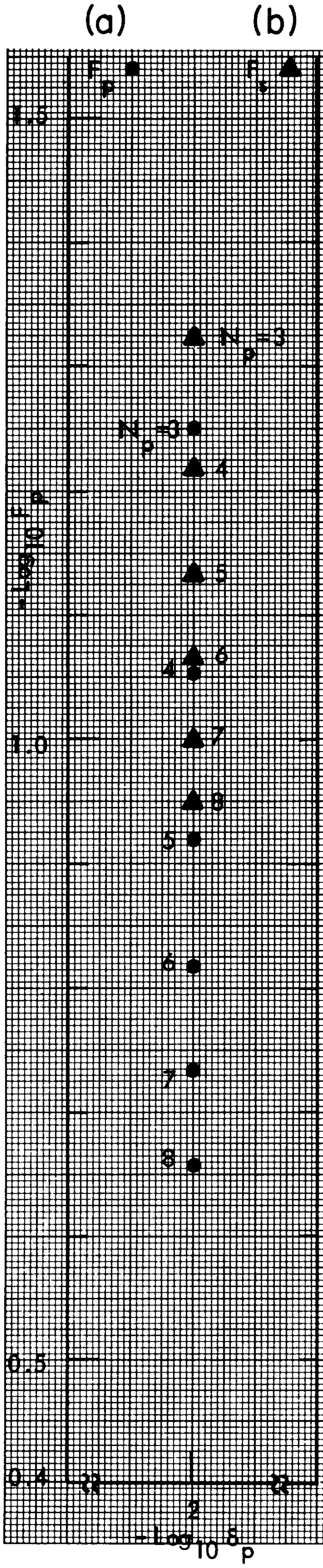


Fig. B-29. N = 15, δ_s = 0.01.

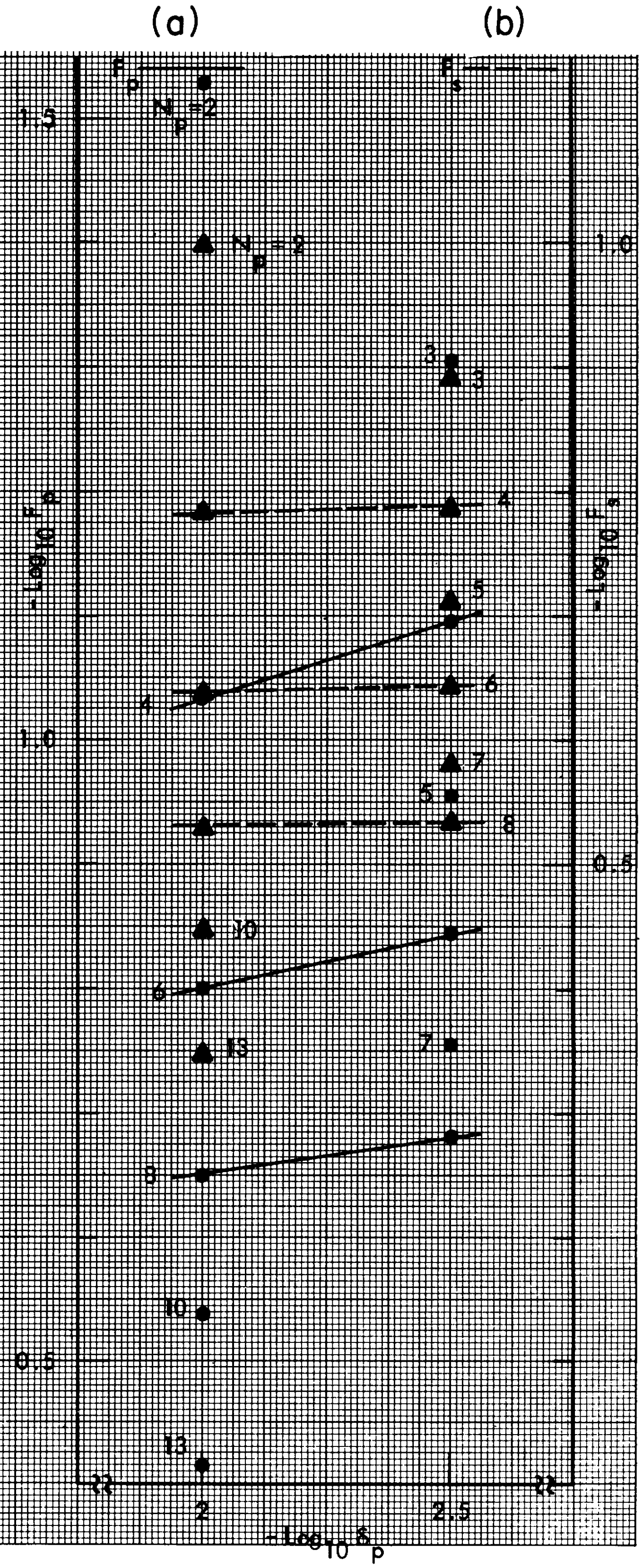


Fig. B-30. N = 15, δ_s = 0.0031623.

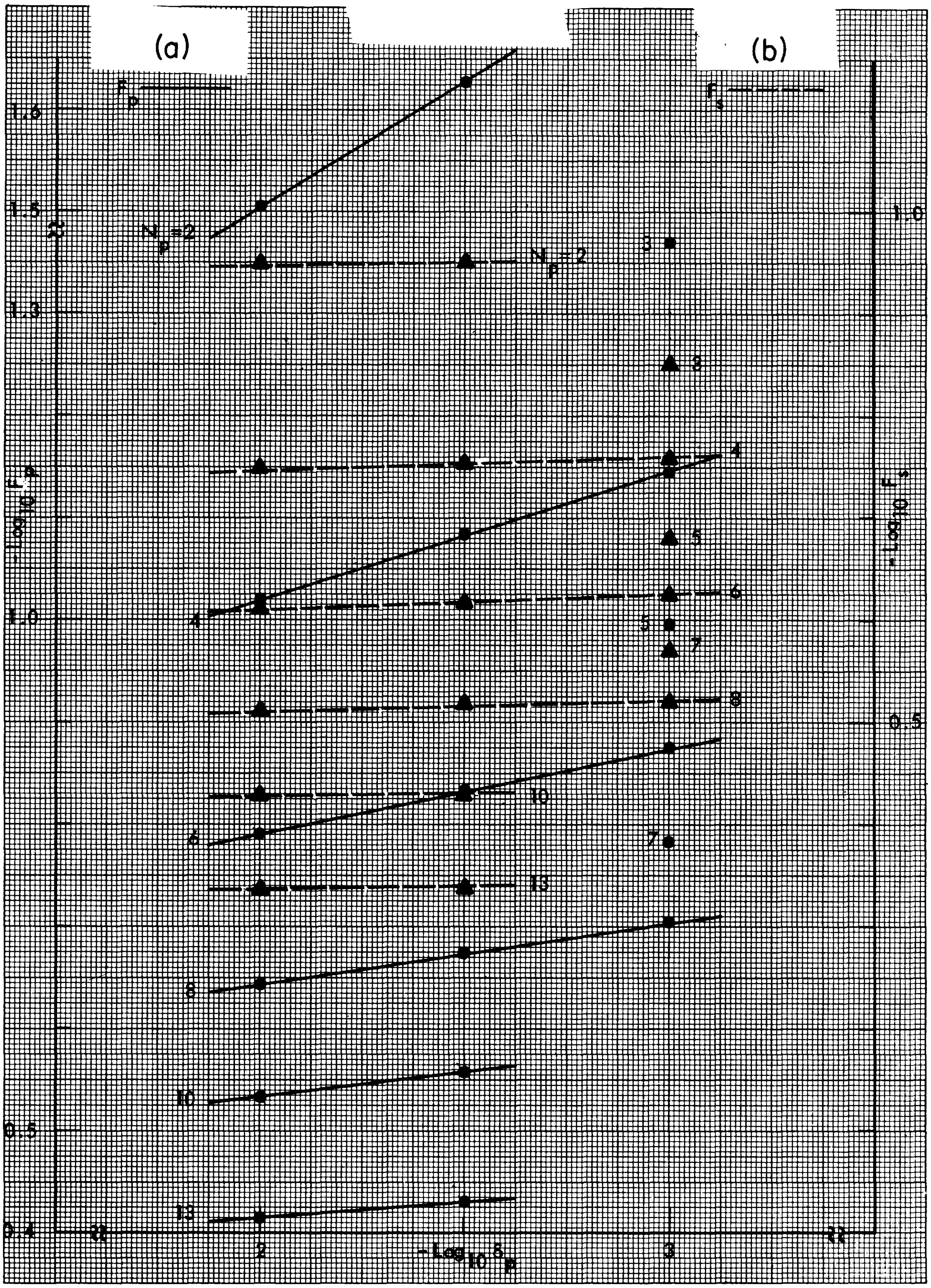


Fig. B-31. N = 15, δ_S = 0.001.

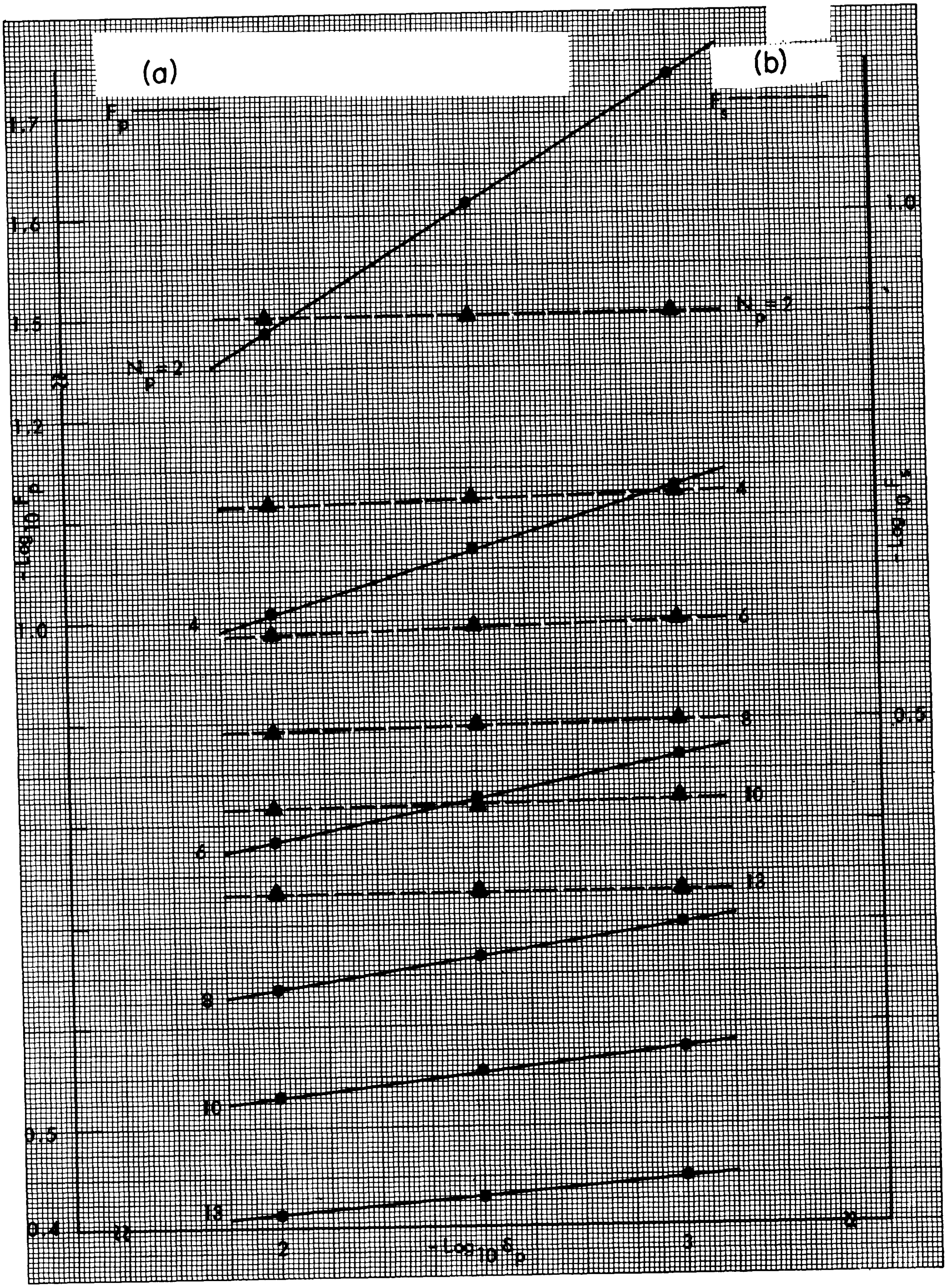


Fig. B-32. N = 15, δ_s = 0.00031623.

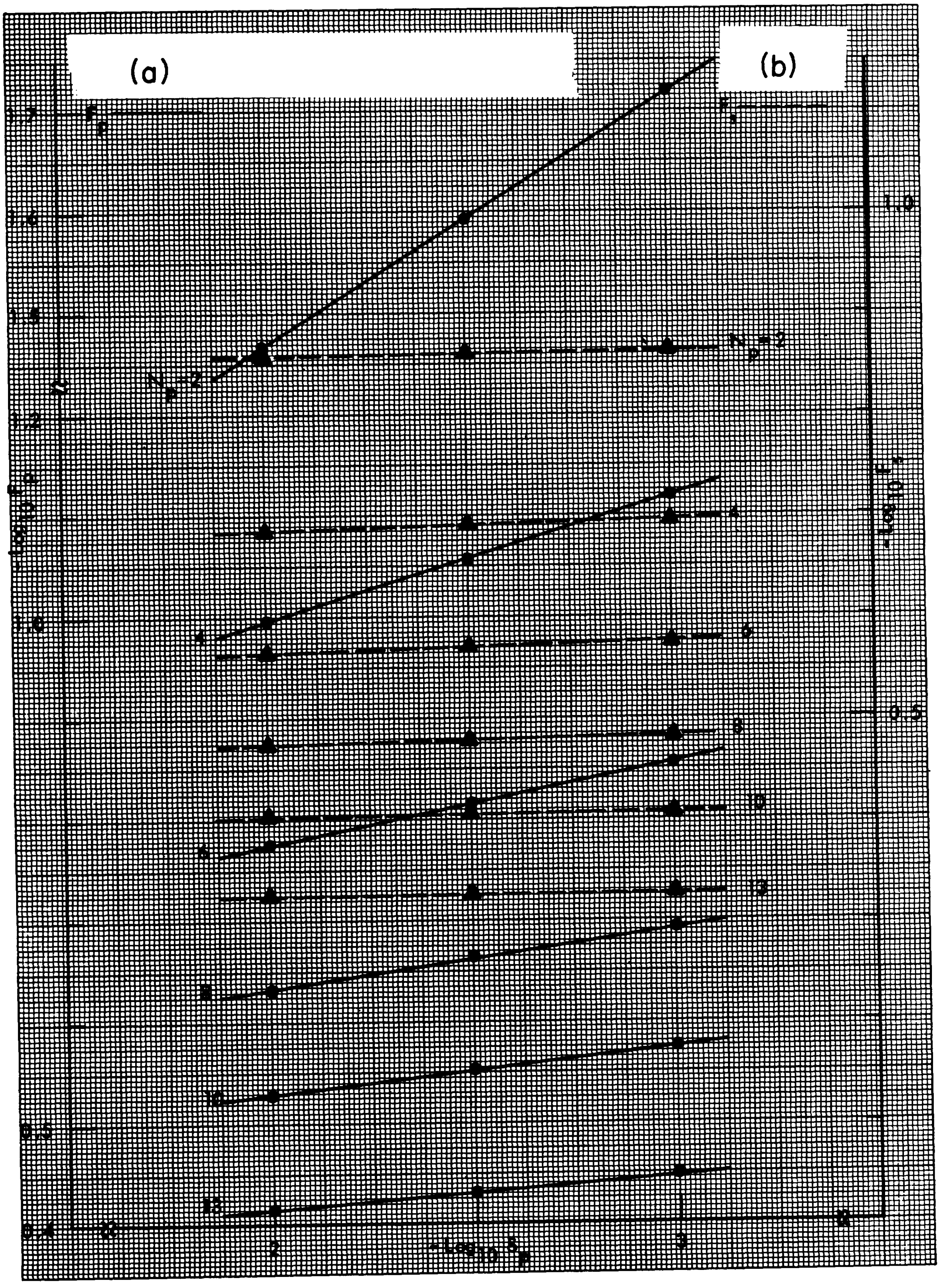


Fig. B-33. N = 15, δ_S = 0.0001.

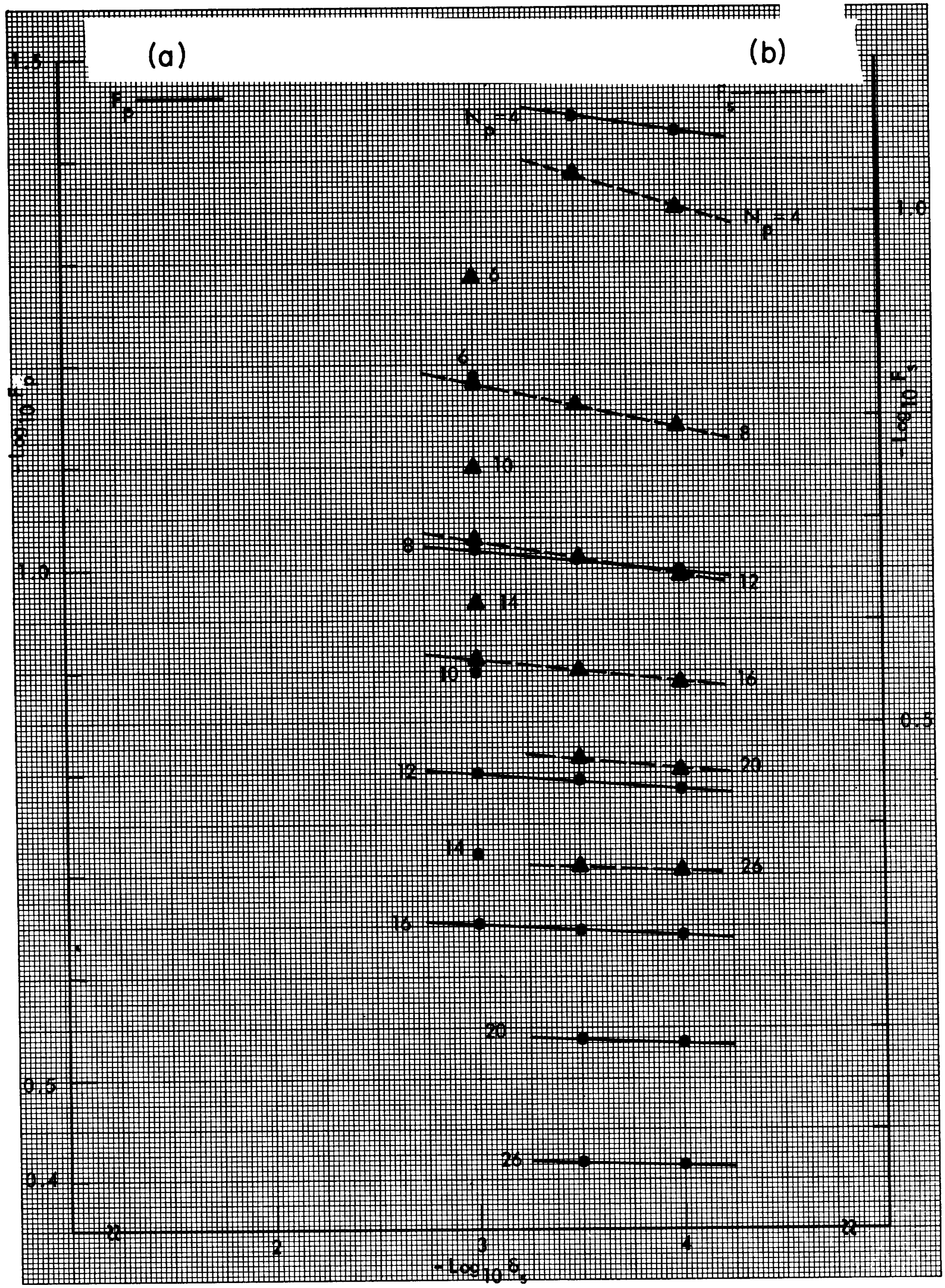


Fig. B-34. N = 31, $\delta_p = 0.001$.

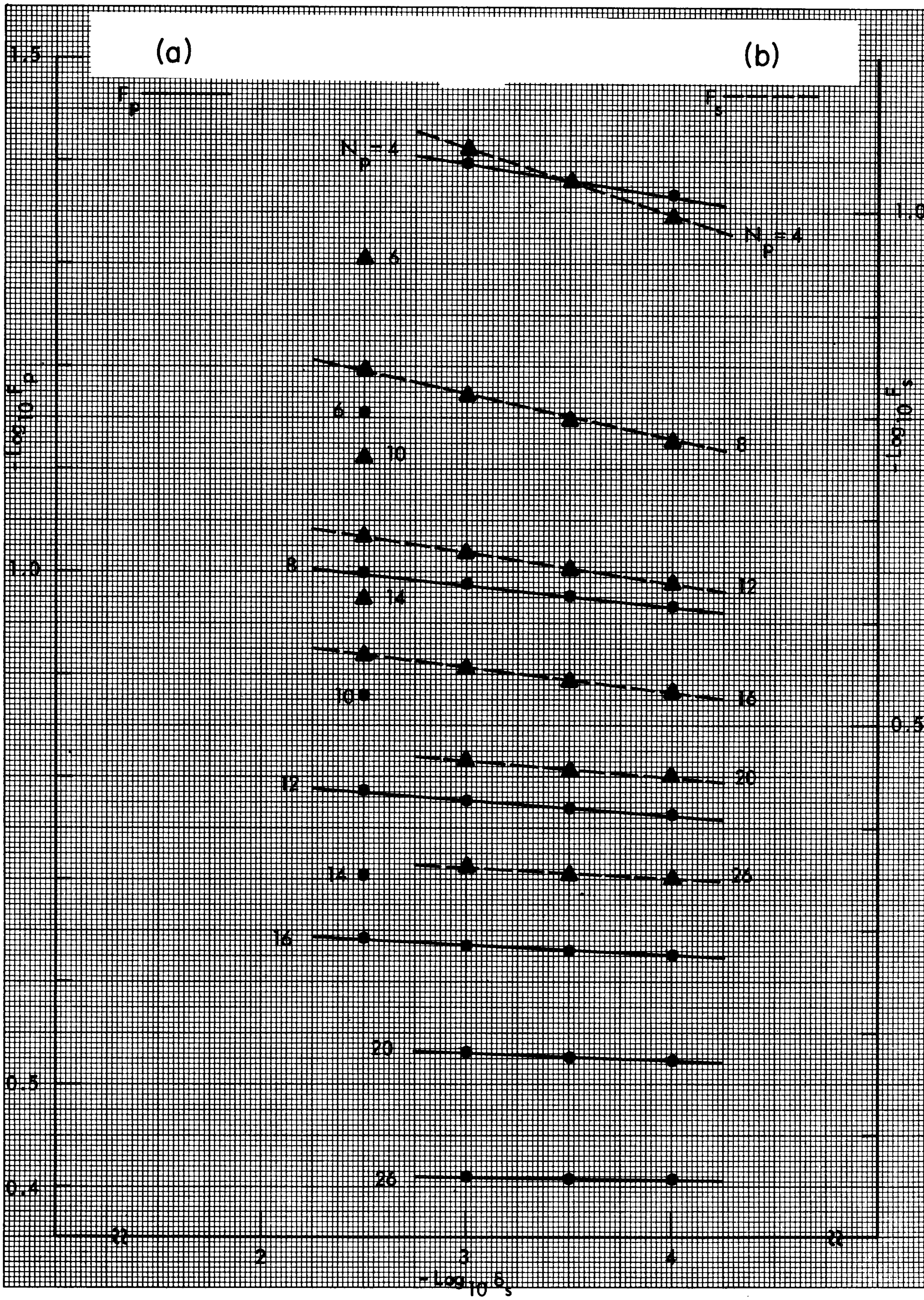


Fig. B-35. N = 31, δ_p = 0.0031623.

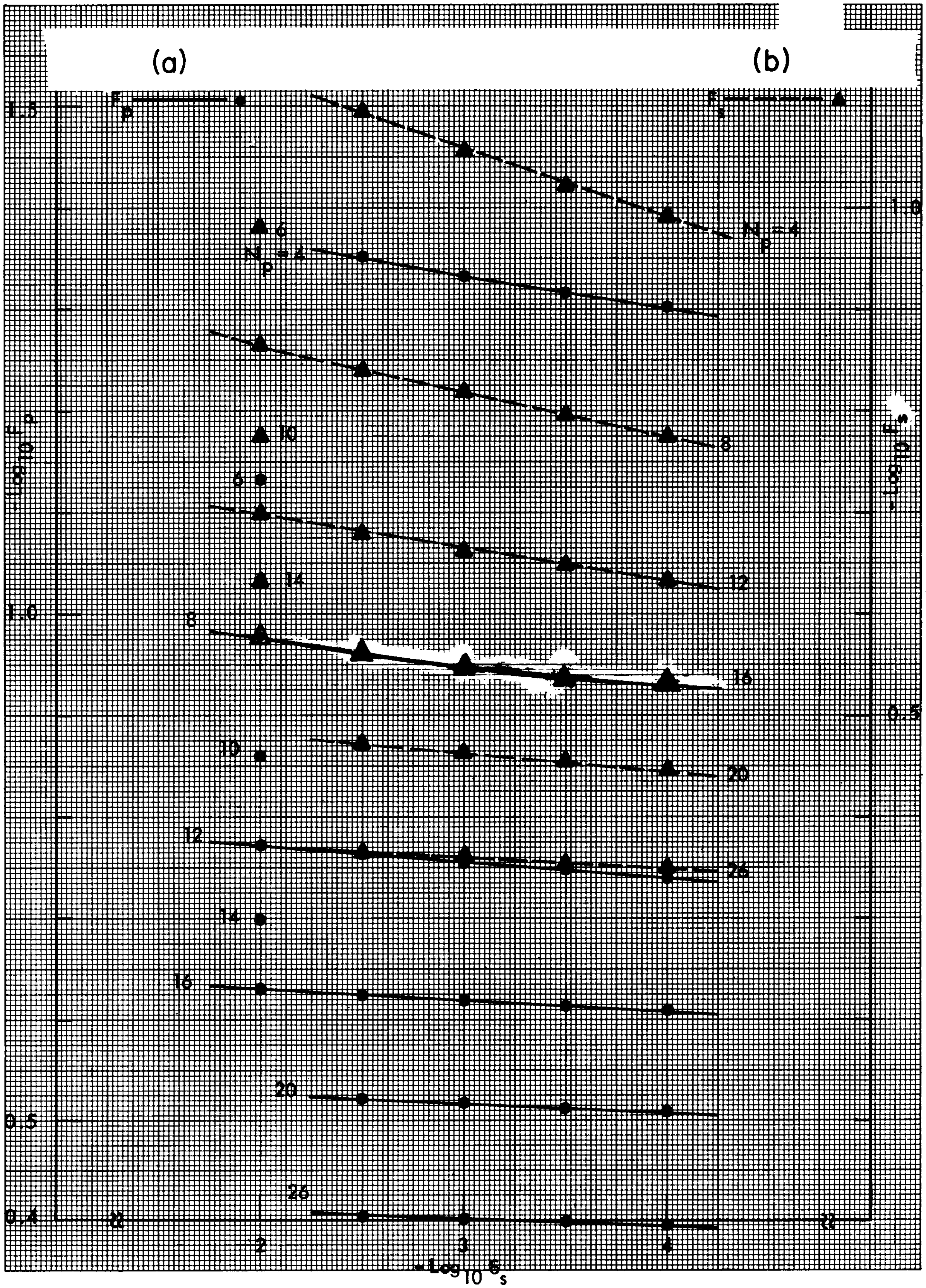


Fig. B-36. N = 31, $\delta_p = 0.01$.

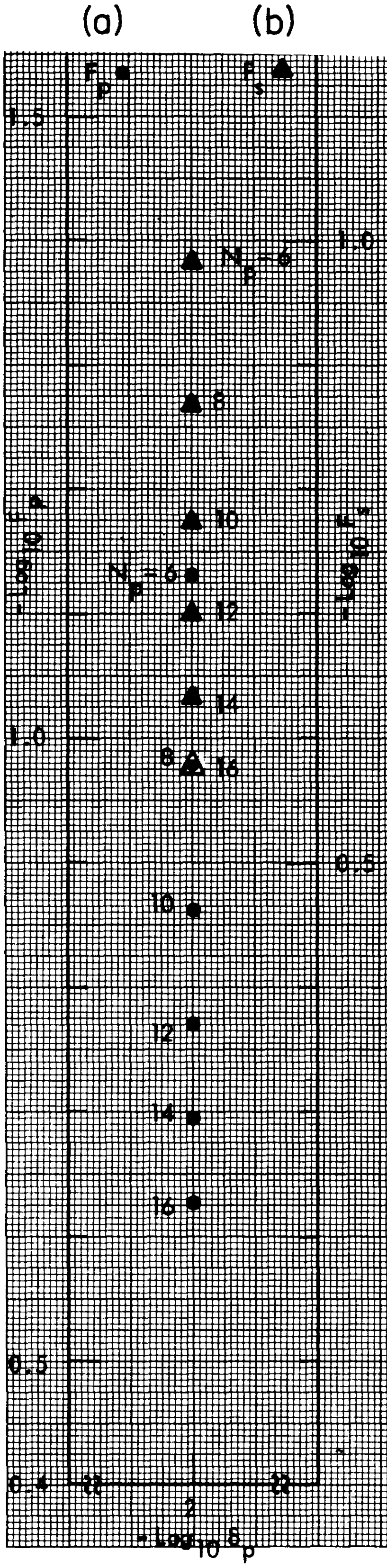


Fig. B-37. $N = 31$, $\delta_s = 0.01$.

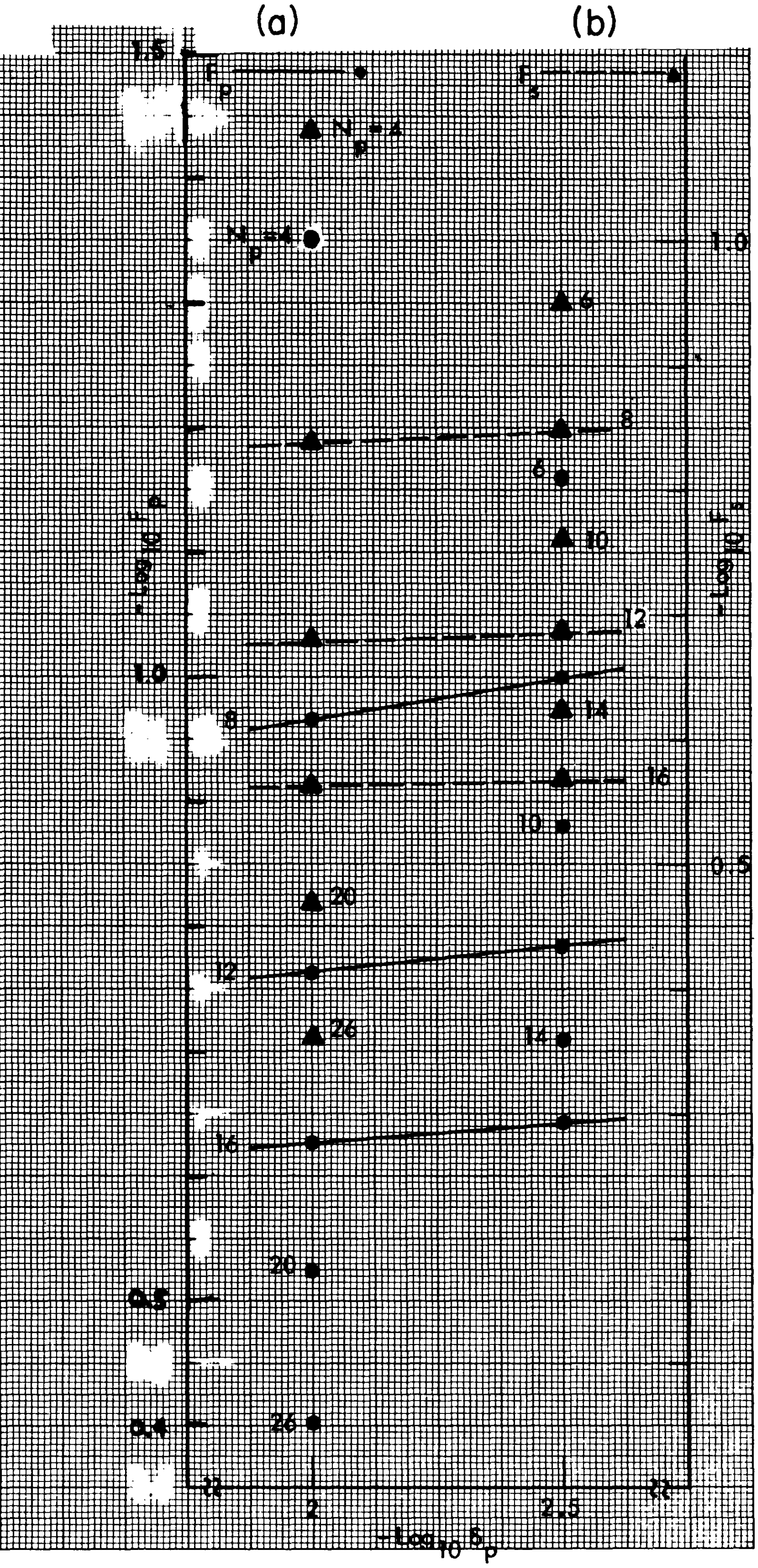


Fig. B-38. $N = 31$, $\delta_s = 0.0031623$.

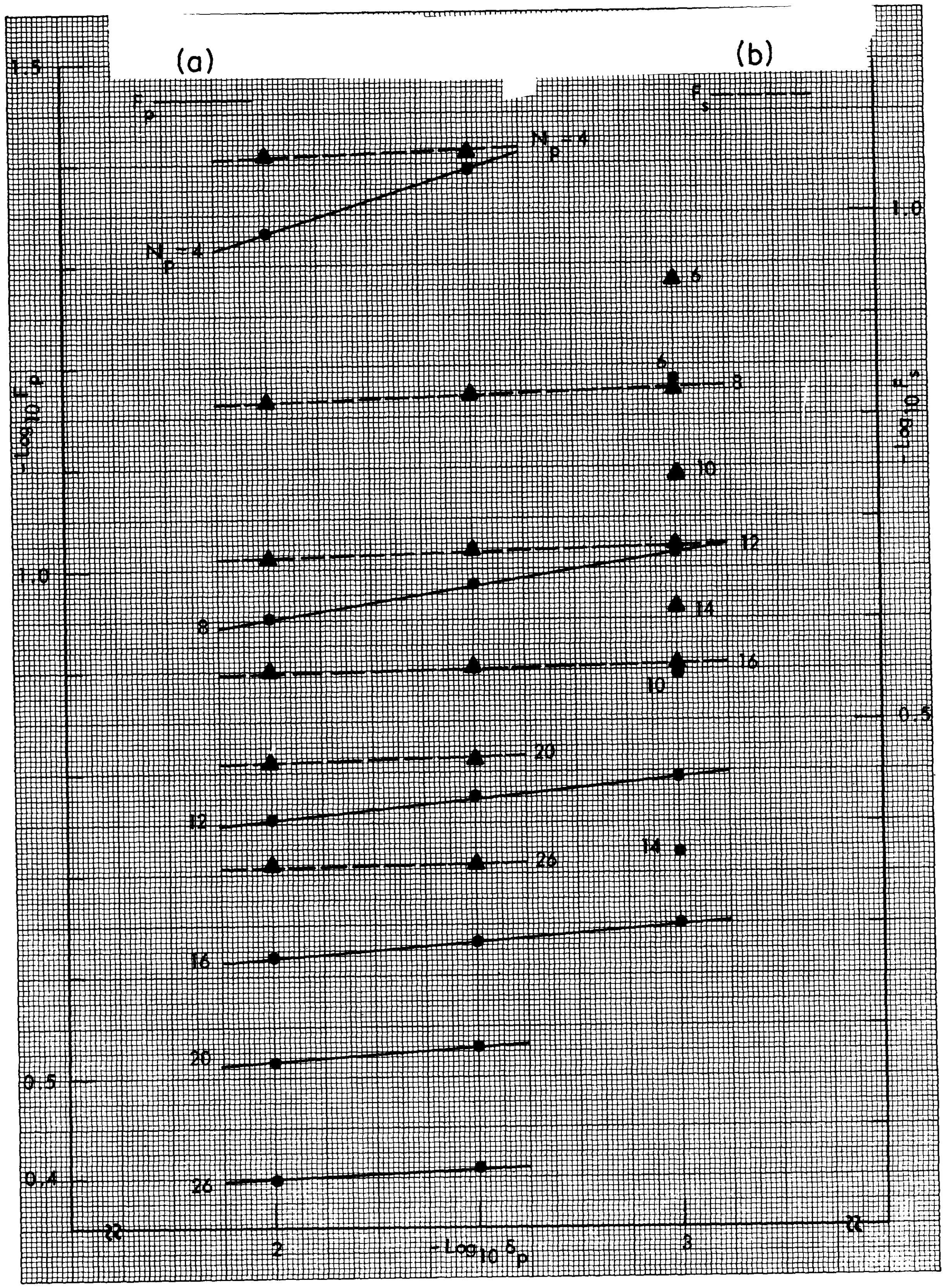


Fig. B-39. N = 31, δ_s = 0.001.

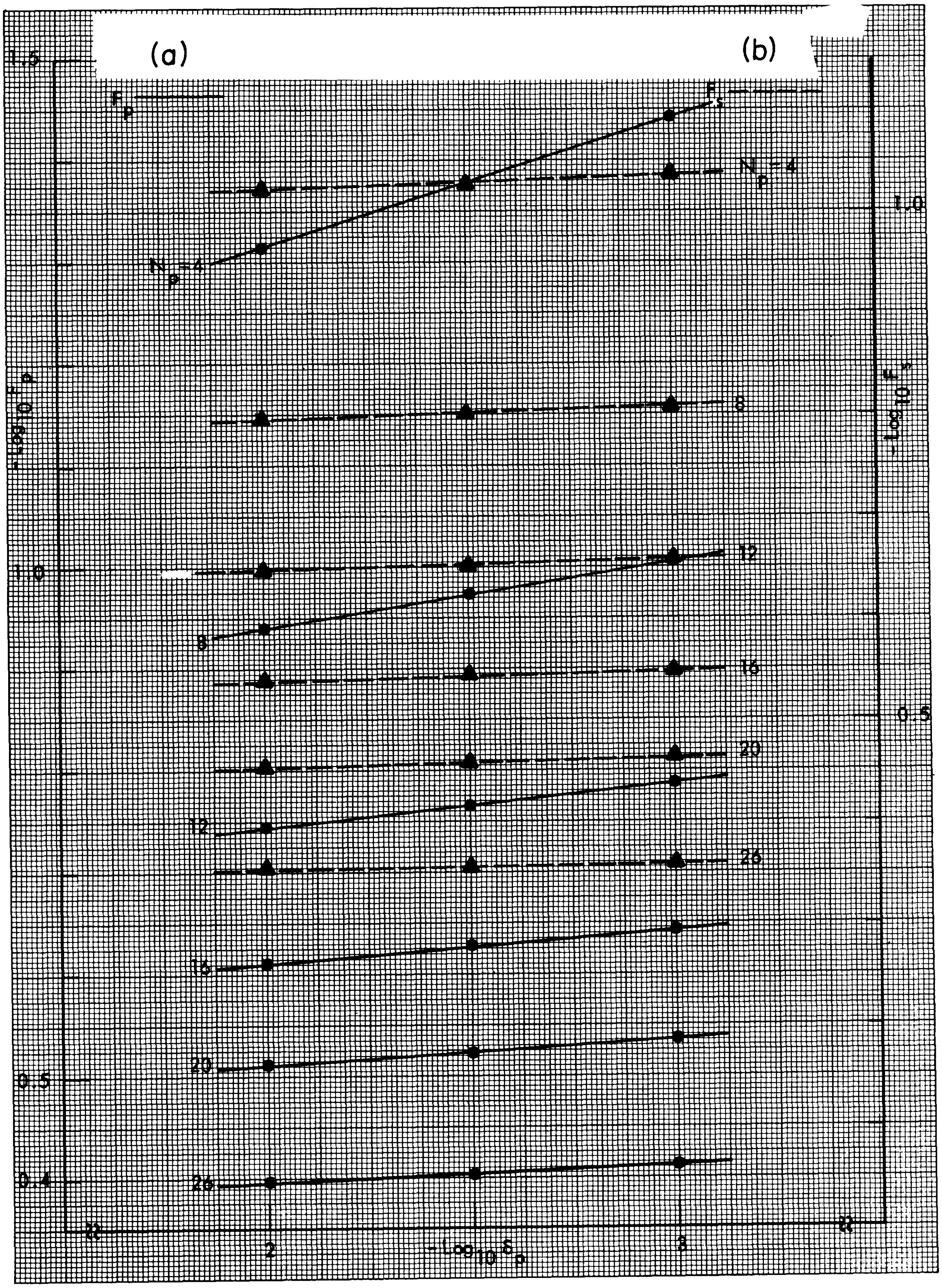


Fig. B-40. N = 31, δ_s = 0.00031623.

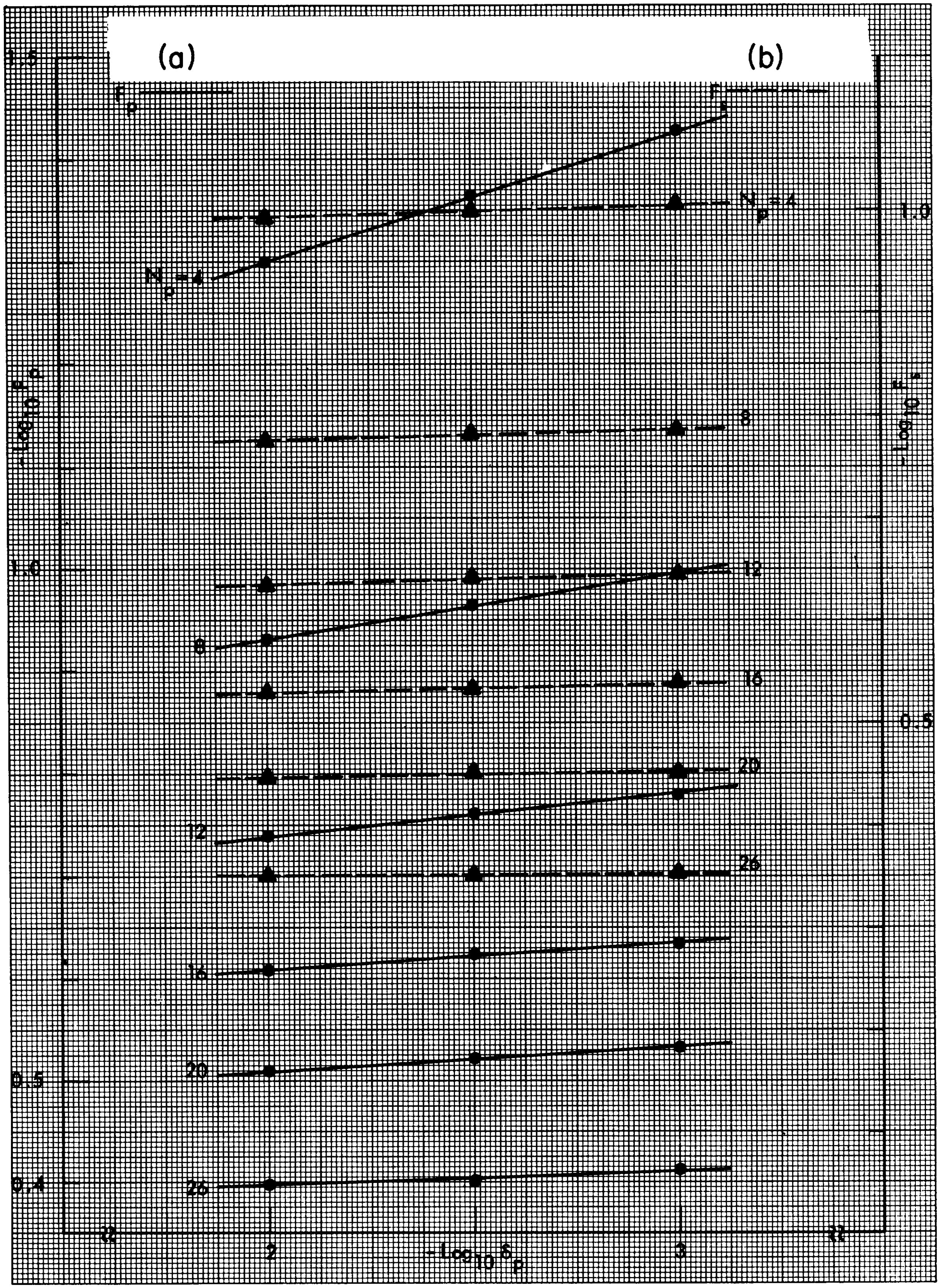


Fig. B-41. N = 31, $\delta_s = 0.0001$.

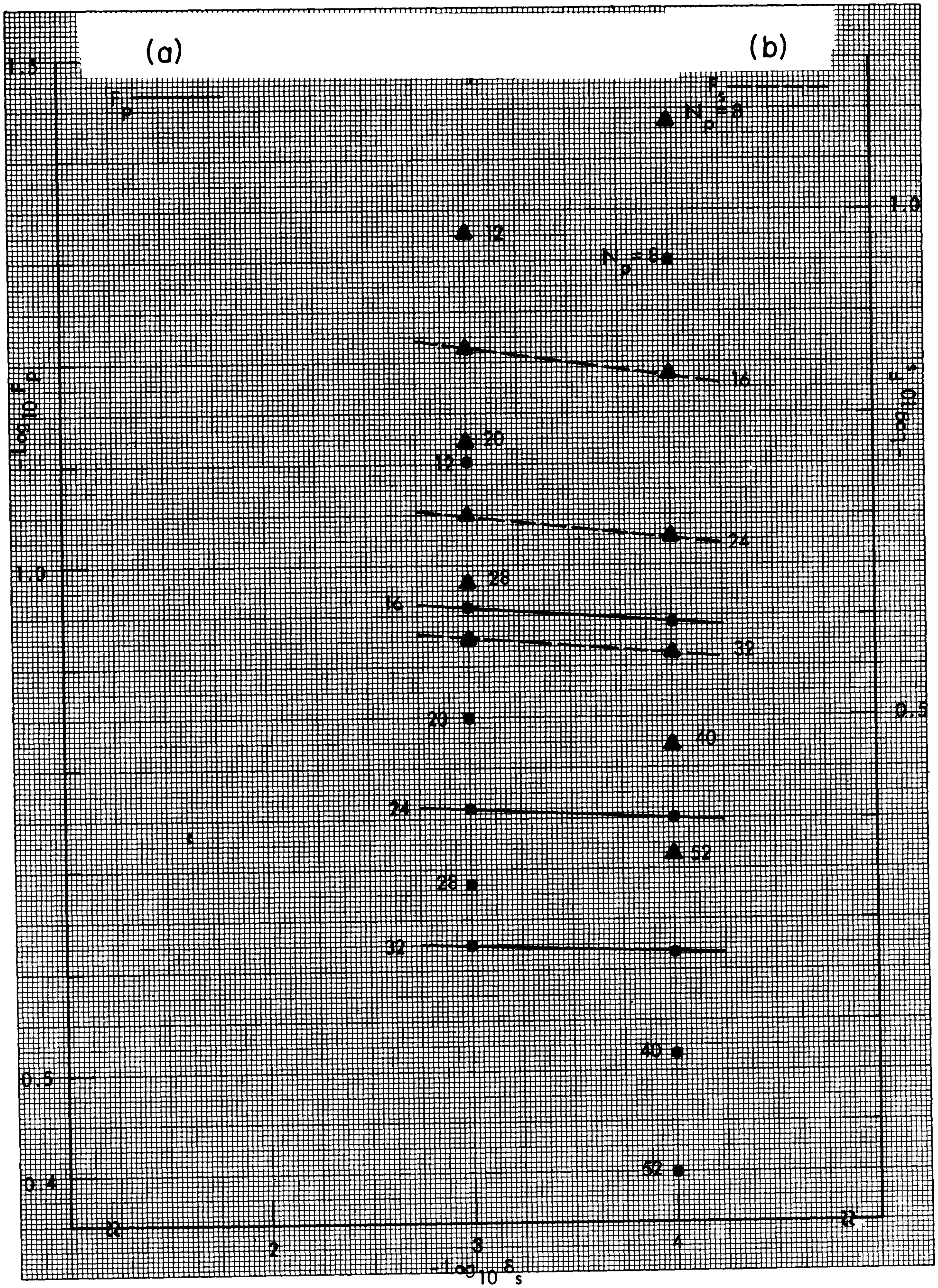


Fig. B-42. N = 63, δ_p = 0.001.

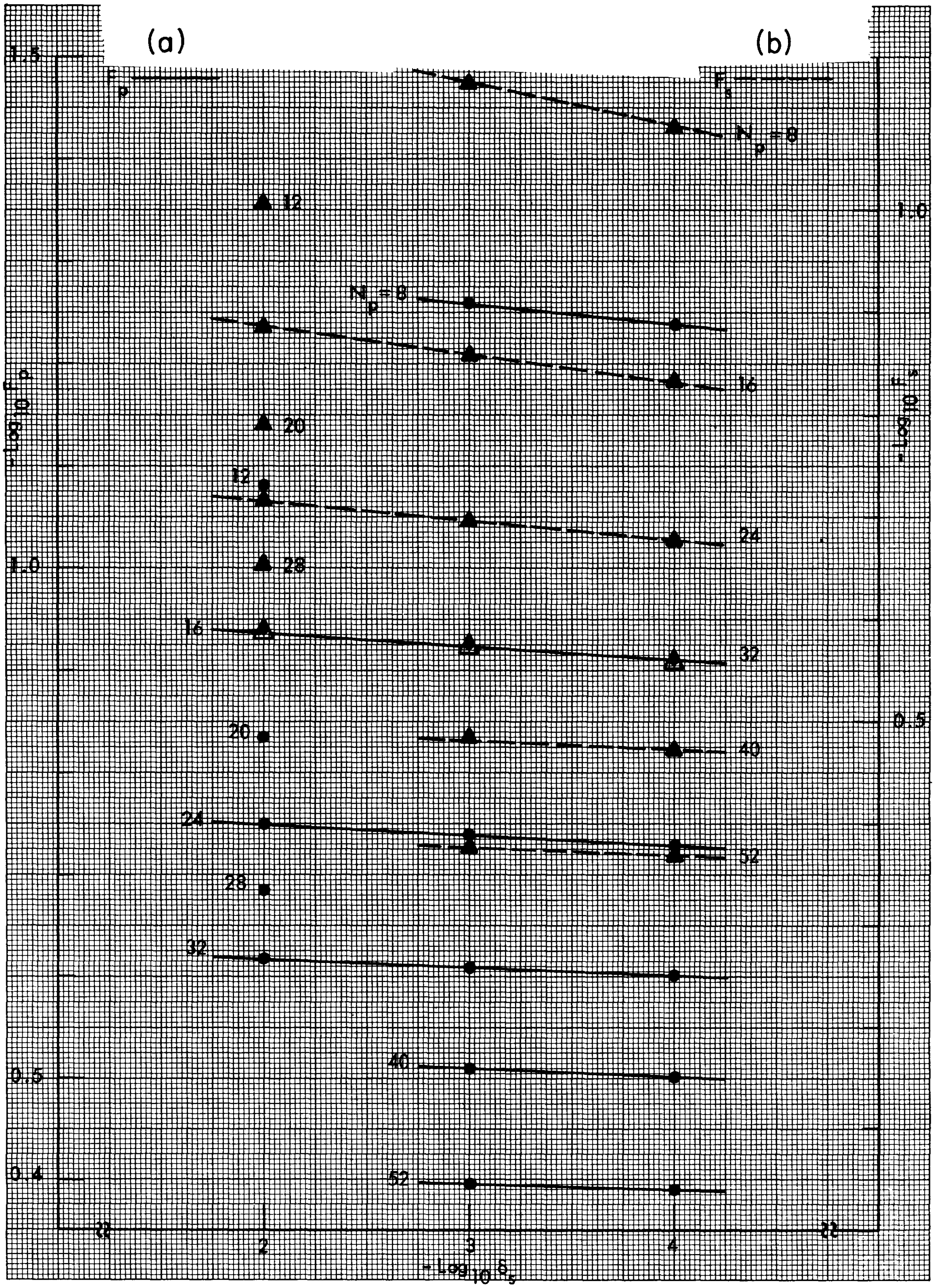


Fig. B-43. N = 63, $\delta_p = 0.01$.

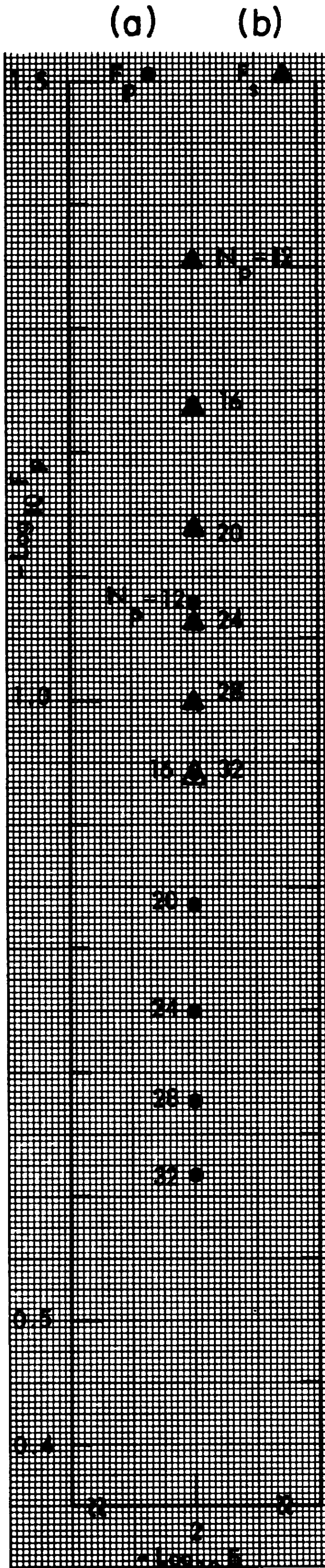


Fig. B-44. N = 63, δ_s = 0.01.

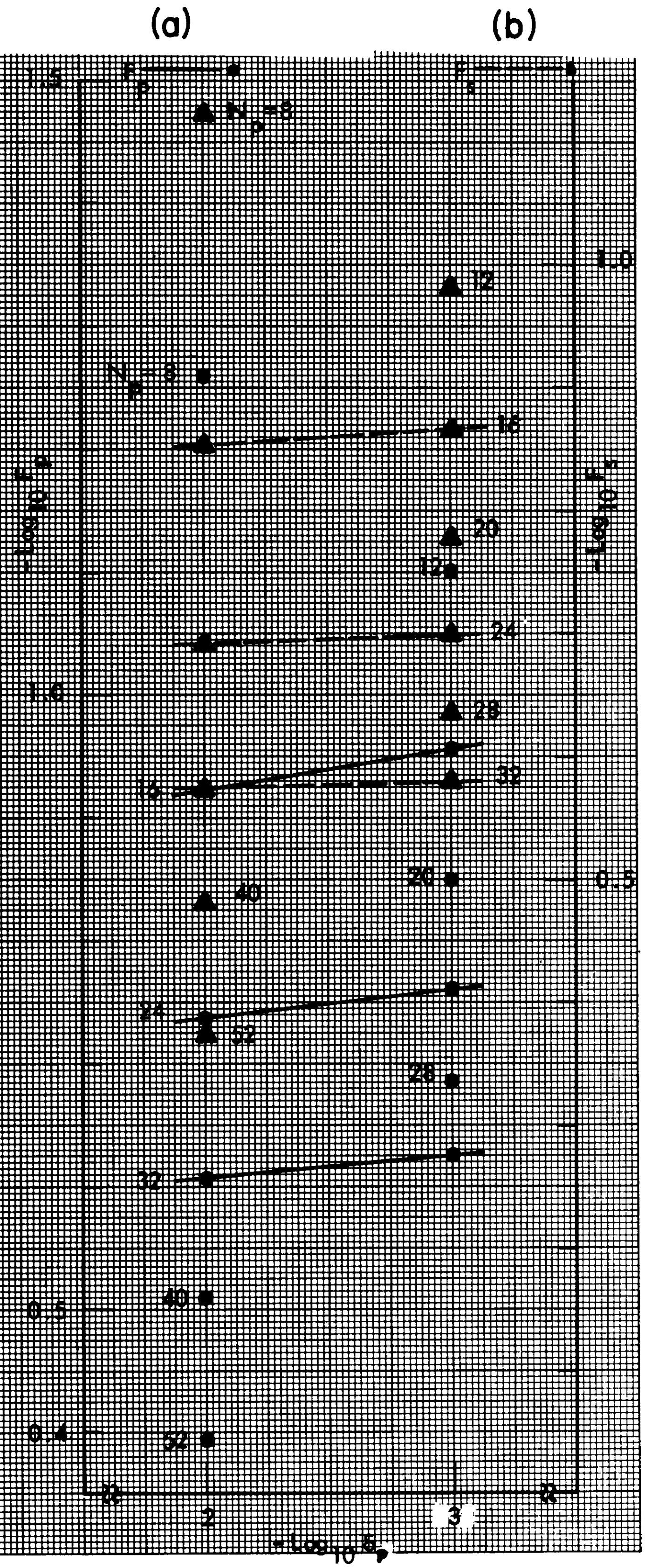


Fig. B-45. N = 63, δ_s = 0.01.

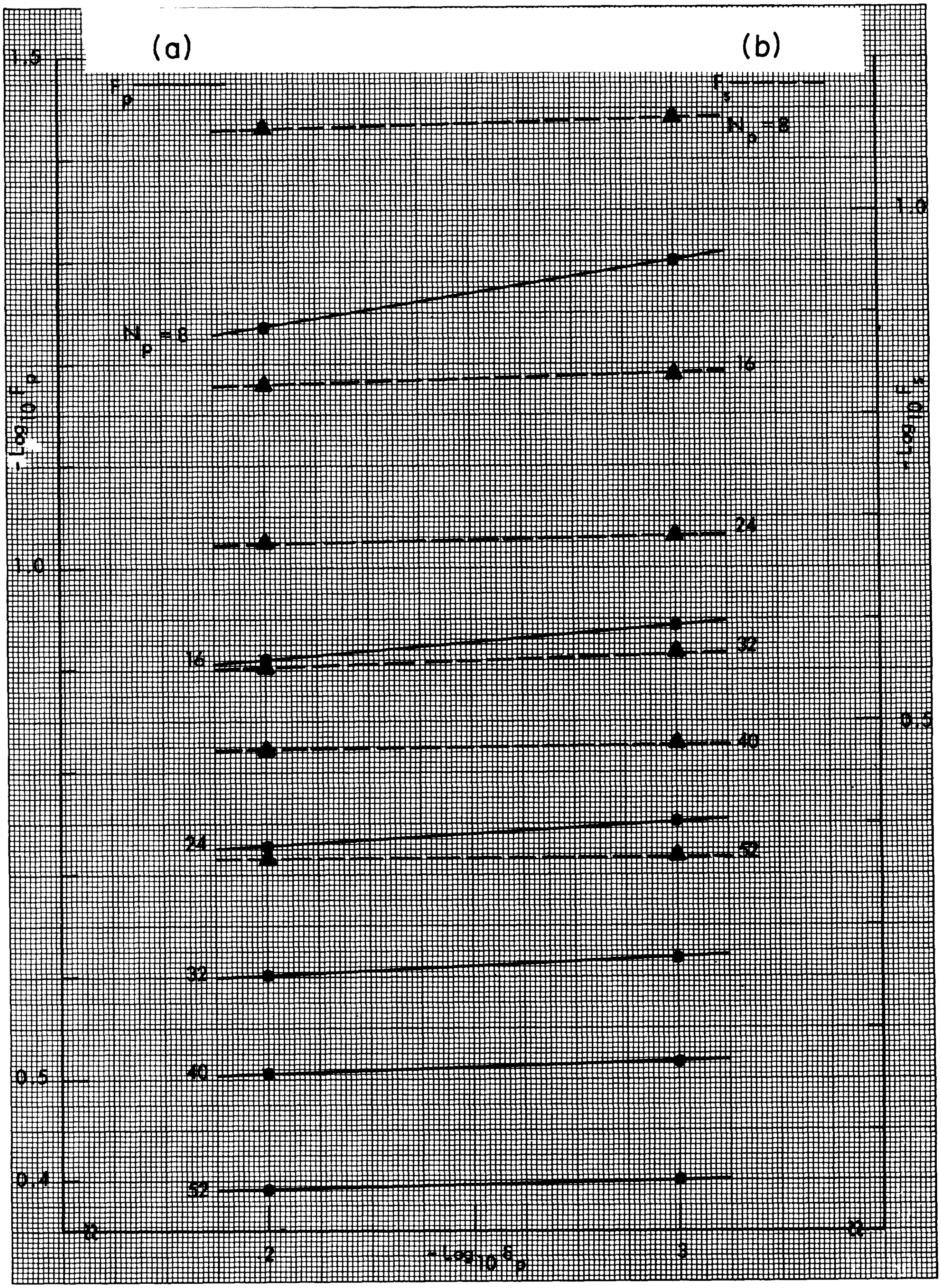


Fig. B-46. N = 63, δ_s = 0.0001.

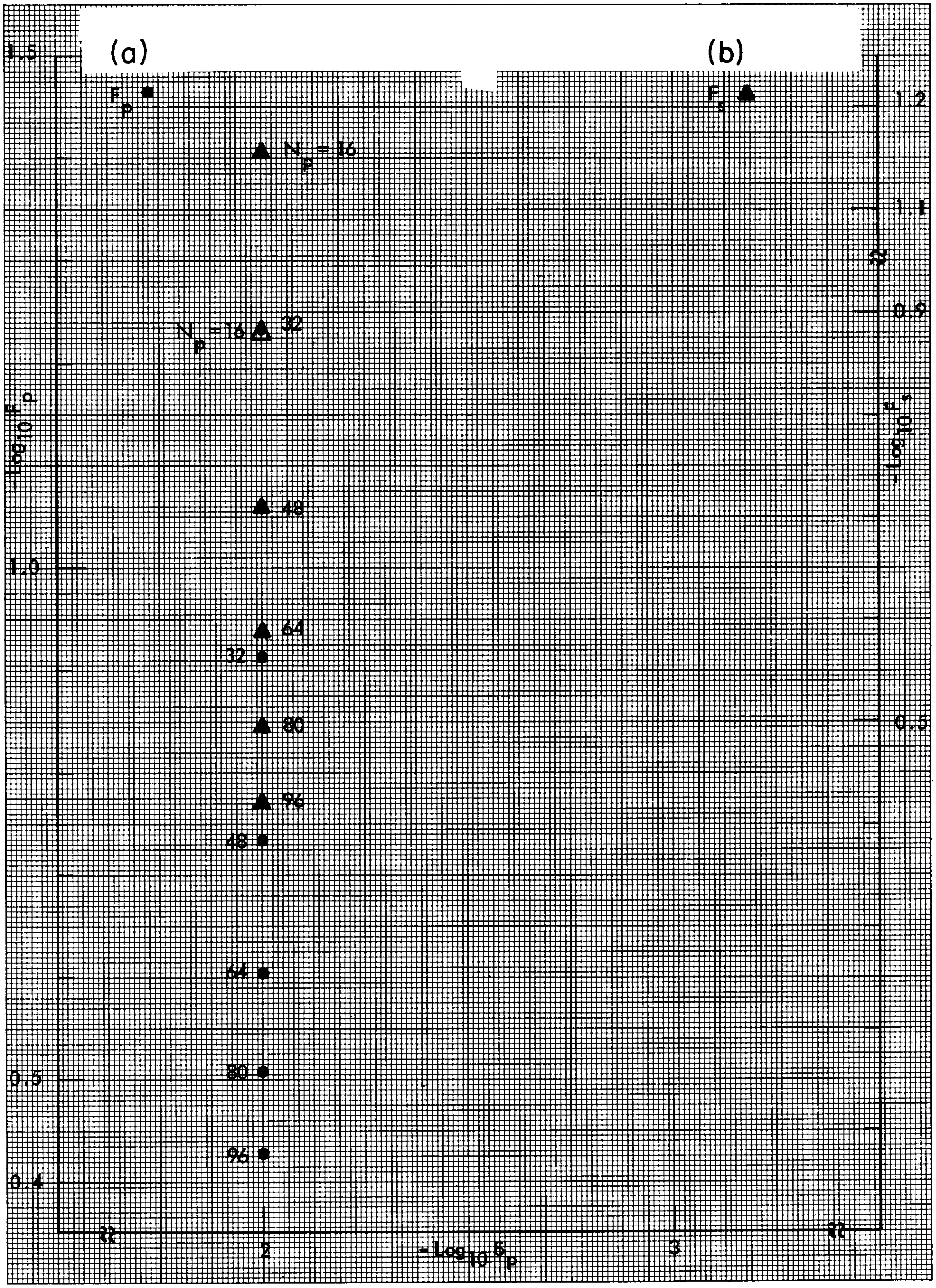


Fig. B-47. N = 127, $\delta_s = 0.001$.

APPENDIX C

Unit Sample Response

The unit sample response for each of the 535 filters in Appendix A is presented here, referenced by the same number as the filter. The values presented are the unit sample response coefficients for the zero-phase filters. For these filters $h_o(n) = h_o(-n)$; $n = 1, 2, \ldots, N$, and it is sufficient to present the values $h_o(n)$; $n = 0, 1, 2, \ldots, N$ of only $N+1$ samples. These coefficients are identified by an index value (Column 2), and by other column headings. For example, the listing of filter No. 130 shows that the unit sample response of this filter is of length 11 samples and it is listed on two lines. The first line with the index value $k = 0$ lists $h_o(0)$-$h_o(6)$, while the second line with $k = 7$ lists $h_o(7)$-$h_o(10)$. To translate these zero-phase coefficients into the corresponding linear-phase coefficients, it is only necessary to use Eq. 12.

The coefficient values presented in this report have been represented to nine decimal places and were computed using a revised version of the design algorithm. For these reasons they may be somewhat different than those originally presented in the M.S. Thesis on which the report is based.

NO.	INDEX	HO(K)	HO(K+1)	HO(K+2)	HO(K+3)	HO(K+4)	HO(K+5)	HO(K+6)
1.	K= 0	0.191610992	0.172640026	0.125165343	0.070798695	0.029029086	0.007061139	
2.	K= 0	0.202195883	0.179749191	0.125038147	0.065730810	0.024034783	0.004848924	
3.	K= 0	0.210808396	0.185260653	0.124393523	0.061454598	0.020427171	0.003559637	
4.	K= 0	0.179002404	0.163776696	0.124519408	0.076670468	0.035979226	0.011133753	
5.	K= 0	0.192047060	0.173028231	0.125436187	0.070941269	0.029080715	0.007070888	
6.	K= 0	0.202650368	0.180149078	0.125307322	0.065864027	0.024078824	0.004856318	
7.	K= 0	0.211278200	0.185669839	0.124660730	0.061580092	0.020465583	0.003565464	
8.	K= 0	0.164117396	0.152758241	0.122497201	0.083001614	0.045443989	0.019239921	
9.	K= 0	0.180307329	0.164955020	0.125378489	0.077158511	0.036177166	0.011176869	
10.	K= 0	0.193426192	0.174255848	0.126292765	0.071392238	0.029243995	0.007101715	
11.	K= 0	0.204087913	0.181413710	0.126158714	0.066285431	0.024218120	0.004879724	
12.	K= 0	0.212763965	0.186963975	0.125505805	0.061976995	0.020587061	0.003583900	
13.	K= 0	0.345509350	0.266641796	0.105639100	-0.006491717	-0.028393734	-0.010650057	
14.	K= 0	0.356388628	0.269848347	0.098642170	-0.011663206	-0.027007390	-0.008514155	
15.	K= 0	0.364681780	0.272010088	0.093168795	-0.015115295	-0.025734629	-0.007169757	
16.	K= 0	0.336766958	0.265033066	0.113307297	-0.001779125	-0.031690732	-0.014835007	
17.	K= 0	0.351095498	0.269751191	0.104295433	-0.009659696	-0.030383699	-0.011132035	
18.	K= 0	0.362062454	0.272885501	0.097100914	-0.014836036	-0.028843626	-0.008919064	
19.	K= 0	0.370416820	0.274988770	0.091484964	-0.018280242	-0.027458876	-0.007524066	
20.	K= 0	0.327383995	0.263427496	0.122459769	0.004505325	-0.036151771	-0.022932716	
21.	K= 0	0.346420050	0.270480752	0.110914528	-0.007816344	-0.035833951	-0.015954886	
22.	K= 0	0.360960841	0.275038898	0.101413727	-0.015755489	-0.034144104	-0.012033358	
23.	K= 0	0.372045815	0.278019071	0.093867898	-0.020920113	-0.032311685	-0.009677995	
24.	K= 0	0.380528152	0.280018926	0.087981880	-0.024354074	-0.030720878	-0.008189823	
25.	K= 0	0.499997854	0.300529420	0.000001545	-0.061742615	-0.000000481	0.011713002	
26.	K= 0	0.507937074	0.299367487	-0.005901925	-0.059588429	0.002104323	0.010549799	
27.	K= 0	0.513408244	0.298447788	-0.009838760	-0.057989523	0.003359625	0.009816527	
28.	K= 0	0.499998450	0.303429961	0.000001162	-0.067607701	-0.000000441	0.015758589	
29.	K= 0	0.511498511	0.301837862	-0.008919843	-0.064417899	0.003711094	0.013620365	
30.	K= 0	0.519408643	0.300482512	-0.014788505	-0.061920892	0.005795643	0.012307752	
31.	K= 0	0.524882913	0.299431682	-0.018712975	-0.060095306	0.007037021	0.011478916	
32.	K= 0	0.499999523	0.307080746	0.000000365	-0.075777888	-0.000000112	0.023696885	
33.	K= 0	0.516602814	0.304947615	-0.013599042	-0.071076691	0.007007036	0.019419406	
34.	K= 0	0.528105617	0.302931309	-0.022480451	-0.067077279	0.010677606	0.016895719	
35.	K= 0	0.536015391	0.301292360	-0.028297678	-0.064054608	0.012710888	0.015341103	
36.	K= 0	0.541472554	0.300046027	-0.032167912	-0.061875220	0.013906594	0.014353961	

NO.	INDEX	HO(K)	HO(K+1)	HO(K+2)	HO(K+3)	HO(K+4)	HO(K+5)	HO(K+6)
37.	K= 0	0.657640874	0.264852643	-0.106307209	-0.004794672	0.027315963	-0.010387026	
38.	K= 0	0.659431100	0.263823688	-0.106655955	-0.003858998	0.026715569	-0.010239739	
39.	K= 0	0.668712974	0.261827946	-0.114380659	0.001361761	0.029483769	-0.014230285	
40.	K= 0	0.671813786	0.259983063	-0.114902675	0.003046533	0.028284442	-0.013899244	
41.	K= 0	0.673557281	0.258935809	-0.115170598	0.003965691	0.027626503	-0.013717096	
42.	K= 0	0.682026029	0.257764578	-0.124183297	0.010399420	0.031460963	-0.021454506	
43.	K= 0	0.687364459	0.254456043	-0.124897480	0.013448421	0.028965361	-0.020654440	
44.	K= 0	0.690362871	0.252563357	-0.125213444	0.015072364	0.027611170	-0.020214755	
45.	K= 0	0.692073345	0.251475215	-0.125369310	0.015969560	0.026857786	-0.019969795	
46.	K= 0	0.808524013	0.172519088	-0.125079453	0.070752144	-0.029011272	0.007057246	
47.	K= 0	0.808567643	0.172480226	-0.125052392	0.070737898	-0.029006083	0.007056229	
48.	K= 0	0.821408212	0.163405180	-0.124247670	0.076515377	-0.035915527	0.011119235	
49.	K= 0	0.821538687	0.163287401	-0.124161720	0.076466501	-0.035898802	0.011114985	
50.	K= 0	0.821579993	0.163250089	-0.124134660	0.076451182	-0.035889417	0.011113491	
51.	K= 0	0.837095976	0.151644230	-0.121642649	0.082470000	-0.045195494	0.019175466	
52.	K= 0	0.837479591	0.151291966	-0.121372461	0.082302034	-0.045116890	0.019155100	
53.	K= 0	0.837601125	0.151180685	-0.121287107	0.082248747	-0.045092065	0.019148801	
54.	K= 0	0.837639451	0.151145458	-0.121260107	0.082231998	-0.045084193	0.019146714	
55.	K= 0	0.142414808	0.134460390	0.112873018	0.083538234	0.053609025	0.028916124	0.012310486
	K= 7	0.003585178						
56.	K= 0	0.151833951	0.142100275	0.116133809	0.092068503	0.049175069	0.024083920	0.008944988
	K= 7	0.002076252						
57.	K= 0	0.159963369	0.148505747	0.118422151	0.080218375	0.045154765	0.020267252	0.006666292
	K= 7	0.001283563						
58.	K= 0	0.131759644	0.125578225	0.108495235	0.084398091	0.058330096	0.034948751	0.017294716
	K= 7	0.006655890						
59.	K= 0	0.142741144	0.134766281	0.113124013	0.083716571	0.053716365	0.028968573	0.012329500
	K= 7	0.003589027						
60.	K= 0	0.152178586	0.142420530	0.116389811	0.082242489	0.049273152	0.024127755	0.008959092
	K= 7	0.002078724						
61.	K= 0	0.160323203	0.148837626	0.118681550	0.080387890	0.045245130	0.020304658	0.006677162
	K= 7	0.001285250						
62.	K= 0	0.119731545	0.115259945	0.102662563	0.084187686	0.062951744	0.042185791	0.024519790
	K= 7	0.013366375						
63.	K= 0	0.132728338	0.126494169	0.109267294	0.084972799	0.058700610	0.035148092	0.017377250
	K= 7	0.006675407						

NO.	INDEX	HO(K)	HO(K+1)	HO(K+2)	HO(K+3)	HO(K+4)	HO(K+5)	HO(K+6)
64.	K= 0	0.143773377	0.135733724	0.113917828	0.084280550	0.054055769	0.029134374	0.012389593
	K= 7	0.003601190						
65.	K= 0	0.153268814	0.143433571	0.117199600	0.082792580	0.049583208	0.024266243	0.009003606
	K= 7	0.002086530						
66.	K= 0	0.161462128	0.149887919	0.119502008	0.080923855	0.045530438	0.020422541	0.006711345
	K= 7	0.001290524						
67.	K= 0	0.259102166	0.224397242	0.140427887	0.051860780	-0.004750084	-0.021754768	-0.015228808
	K= 7	-0.005003184						
68.	K= 0	0.270606101	0.230973005	0.137350619	0.043724678	-0.010199610	-0.021705359	-0.012624960
	K= 7	-0.003321353						
69.	K= 0	0.280252516	0.236174285	0.134221256	0.036955163	-0.013981745	-0.021059282	-0.010590687
	K= 7	-0.002345166						
70.	K= 0	0.249551535	0.219193280	0.143893421	0.060024250	0.000669812	-0.022454120	-0.019338917
	K= 7	-0.008344464						
71.	K= 0	0.263449073	0.227580369	0.140986562	0.050140660	-0.007206563	-0.023581609	-0.016045026
	K= 7	-0.005179971						
72.	K= 0	0.275070488	0.234150767	0.137706220	0.041799892	-0.012661502	-0.023372032	-0.013291400
	K= 7	-0.003448243						
73.	K= 0	0.284826994	0.239349604	0.134401262	0.034866732	-0.016431663	-0.022591703	-0.011148576
	K= 7	-0.002440217						
74.	K= 0	0.239914656	0.213842154	0.147439539	0.069101691	0.007544752	-0.022649501	-0.024941582
	K= 7	-0.015294209						
75.	K= 0	0.256982207	0.224724472	0.145019770	0.057055317	-0.003962524	-0.026245650	-0.021257751
	K= 7	-0.008824624						
76.	K= 0	0.271139741	0.233112633	0.141673028	0.046675231	-0.011923973	-0.027031090	-0.017568853
	K= 7	-0.005506732						
77.	K= 0	0.282976866	0.239669621	0.138012171	0.037953977	-0.017386068	-0.026520319	-0.014535408
	K= 7	-0.003682319						
78.	K= 0	0.292893946	0.244833052	0.134378731	0.030737296	-0.021110766	-0.025479283	-0.012189861
	K= 7	-0.002616063						
79.	K= 0	0.378025949	0.285446644	0.096408784	-0.031662788	-0.045169368	-0.008891083	0.009747468
	K= 7	0.005607039						
80.	K= 0	0.389584363	0.288416028	0.087808430	-0.037631493	-0.042042091	-0.004656717	0.009612303
	K= 7	0.004201040						
81.	K= 0	0.398895502	0.290485382	0.080707669	-0.041782763	-0.039133415	-0.001750327	0.009202857
	K= 7	0.003322549						

NO.	INDEX	HO(K)	HO(K+1)	HO(K+2)	HO(K+3)	HO(K+4)	HO(K+5)	HO(K+6)
82.	K= 0	0.373034716	0.285472333	0.102136016	-0.030134905	-0.050473876	-0.012692455	0.011820368
	K= 7	0.008935865						
83.	K= 0	0.387520432	0.289518595	0.091391385	-0.038554348	-0.046835605	-0.006243136	0.012224384
	K= 7	0.006319199						
84.	K= 0	0.399194539	0.292277157	0.082409918	-0.044306487	-0.043122634	-0.001863225	0.011826776
	K= 7	0.004761916						
85.	K= 0	0.408580601	0.294166327	0.075031757	-0.048240997	-0.039769147	0.001106087	0.011212472
	K= 7	0.003783886						
86.	K= 0	0.368285716	0.285756290	0.108243465	-0.028610740	-0.057076607	-0.017990187	0.014690179
	K= 7	0.015844263						
87.	K= 0	0.386640012	0.291313529	0.094670951	-0.040665735	-0.053003389	-0.007864557	0.016721733
	K= 7	0.010507058						
88.	K= 0	0.401318729	0.294964194	0.083209276	-0.048670854	-0.048150718	-0.001046380	0.016531933
	K= 7	0.007502753						
89.	K= 0	0.413128376	0.297387958	0.073703527	-0.054002620	-0.043523733	0.003492028	0.015676811
	K= 7	0.005701475						
90.	K= 0	0.422646995	0.299005747	0.065910459	-0.057566267	-0.039471865	0.006524537	0.014712747
	K= 7	0.004560728						
91.	K= 0	0.499997318	0.307534158	0.000002038	-0.077195406	-0.000001313	0.024929974	0.000000586
	K= 7	-0.005768619						
92.	K= 0	0.509844899	0.306525826	-0.008291658	-0.074926019	0.004769150	0.022903275	-0.001570869
	K= 7	-0.004832081						
93.	K= 0	0.517319858	0.305549502	-0.014420643	-0.072834969	0.008005809	0.021231961	-0.002470059
	K= 7	-0.004221443						
94.	K= 0	0.499998093	0.309636116	0.000001439	-0.082228482	-0.000001025	0.030094340	0.000000508
	K= 7	-0.009083003						
95.	K= 0	0.512961209	0.308376431	-0.011238199	-0.079240620	0.007110070	0.027093466	-0.002893056
	K= 7	-0.007269729						
96.	K= 0	0.522809446	0.307055652	-0.019499604	-0.076284647	0.011808123	0.024489142	-0.004424788
	K= 7	-0.006129663						
97.	K= 0	0.530277610	0.305844545	-0.025580496	-0.073690593	0.014950901	0.022413120	-0.005274758
	K= 7	-0.005382534						
98.	K= 0	0.499999464	0.312013447	0.000000349	-0.088284373	-0.000000426	0.037242331	0.000000255
	K= 7	-0.015971214						
99.	K= 0	0.517130494	0.310450792	-0.015355986	-0.084360182	0.010855496	0.032748900	-0.005774252
	K= 7	-0.012129959						

NO.	INDEX	HO(K)	HO(K+1)	HO(K+2)	HO(K+3)	HO(K+4)	HO(K+5)	HO(K+6)
100.	K= 0	0.530085742	0.308635831	-0.026509751	-0.080081880	0.017767664	0.028511591	-0.008550797
	K= 7	-0.009815432						
101.	K= 0	0.539922178	0.306896210	-0.034656107	-0.076183140	0.022218585	0.025054295	-0.009944521
	K= 7	-0.008346308						
102.	K= 0	0.547386348	0.305370092	-0.040632743	-0.072903454	0.025129531	0.022384677	-0.010664959
	K= 7	-0.007376194						
103.	K= 0	0.628503203	0.282495797	-0.099562645	-0.026999511	0.043733519	-0.010329694	-0.008251566
	K= 7	0.005162366						
104.	K= 0	0.632952327	0.280396044	-0.101587236	-0.023843132	0.042629614	-0.011154238	-0.007313542
	K= 7	0.004876226						
105.	K= 0	0.636316240	0.281148374	-0.106653214	-0.023037966	0.048040528	-0.015055664	-0.009004895
	K= 7	0.007985611						
106.	K= 0	0.642763495	0.278025448	-0.109470963	-0.018253811	0.046103969	-0.016289964	-0.007303312
	K= 7	0.007387742						
107.	K= 0	0.647207141	0.275808573	-0.111272752	-0.015022937	0.044671163	-0.016972642	-0.006236520
	K= 7	0.007002413						
108.	K= 0	0.645072103	0.279449403	-0.114744842	-0.017736085	0.052951436	-0.022058580	-0.009033188
	K= 7	0.013635624						
109.	K= 0	0.654268622	0.274817228	-0.118605316	-0.010479521	0.049509004	-0.023873217	-0.005787984
	K= 7	0.012285292						
110.	K= 0	0.660599053	0.271494567	-0.120968401	-0.005629186	0.046920773	-0.024718087	-0.003830928
	K= 7	0.011431567						
111.	K= 0	0.664937496	0.269155085	-0.122448027	-0.002385615	0.045065749	-0.025124121	-0.002611466
	K= 7	0.010879461						
112.	K= 0	0.743343174	0.222588956	-0.140060127	0.052752614	0.003435543	-0.020765688	0.014782116
	K= 7	-0.004904889						
113.	K= 0	0.744739413	0.221551955	-0.139835536	0.053239714	0.002706824	-0.020216044	0.014534079
	K= 7	-0.004850589						
114.	K= 0	0.754645050	0.216018515	-0.143099785	0.061470643	-0.003071591	-0.020447865	0.018308338
	K= 7	-0.008082151						
115.	K= 0	0.757034242	0.214197278	-0.142601311	0.062223900	-0.004370194	-0.019352511	0.017742958
	K= 7	-0.007938214						
116.	K= 0	0.758373797	0.213171244	-0.142307222	0.062623858	-0.005076621	-0.018752210	0.017431486
	K= 7	-0.007858433						
117.	K= 0	0.767210186	0.208333611	-0.145815969	0.071426928	-0.011953805	-0.018501781	0.022455256
	K= 7	-0.014549170						

NO.	INDEX	HO(K)	HO(K+1)	HO(K+2)	HO(K+3)	HO(K+4)	HO(K+5)	HO(K+6)
118.	K= 0	0.771245360	0.205170453	-0.144753695	0.072523773	-0.014233161	-0.016301841	0.021114200
	K= 7	-0.014142275						
119.	K= 0	0.773521602	0.203373373	-0.144114673	0.073078394	-0.015449438	-0.015114009	0.020382397
	K= 7	-0.013916697						
120.	K= 0	0.774812758	0.202348650	-0.143735826	0.073369741	-0.016117889	-0.014453661	0.019972399
	K= 7	-0.013789602						
121.	K= 0	0.857686043	0.134365380	-0.112794399	0.083481610	-0.053573906	0.028898265	-0.012303539
	K= 7	0.003583232						
122.	K= 0	0.857718647	0.134334803	-0.112769306	0.083463788	-0.053563166	0.028893020	-0.012301635
	K= 7	0.003582856						
123.	K= 0	0.868545055	0.125289619	-0.108251631	0.084216416	-0.058212310	0.034884904	-0.017267864
	K= 7	0.006648943						
124.	K= 0	0.868641794	0.125198066	-0.108174384	0.084158897	-0.058175221	0.034865018	-0.017259661
	K= 7	0.006646987						
125.	K= 0	0.868672371	0.125169158	-0.108149886	0.084140658	-0.058163531	0.034858756	-0.017257046
	K= 7	0.006646346						
126.	K= 0	0.881159604	0.114408493	-0.101922274	0.083606422	-0.062546074	0.041942015	-0.024401702
	K= 7	0.013332848						
127.	K= 0	0.881441116	0.114139497	-0.101688266	0.083422661	-0.062417865	0.041864853	-0.024364166
	K= 7	0.013322234						
128.	K= 0	0.881530166	0.114054382	-0.101614237	0.083364546	-0.062377330	0.041840486	-0.024352334
	K= 7	0.013318896						
129.	K= 0	0.881558299	0.114027441	-0.101590812	0.083346128	-0.062364537	0.041832801	-0.024348557
	K= 7	0.013317812						
130.	K= 0	0.102000117	0.099041104	0.090609014	0.077940702	0.062799275	0.047111899	0.032601934
	K= 7	0.020507056	0.011438407	0.005399145	0.002051170			
131.	K= 0	0.109471262	0.105770051	0.095323920	0.079934001	0.062084053	0.044339530	0.028790627
	K= 7	0.016693104	0.008381642	0.003434183	0.001013115			
132.	K= 0	0.116150260	0.111691833	0.099225640	0.081203103	0.060895950	0.041497096	0.025360532
	K= 7	0.013611175	0.006188918	0.002221724	0.000528784			
133.	K= 0	0.093805373	0.091552436	0.085067272	0.075126708	0.062876463	0.049636789	0.036695972
	K= 7	0.025123172	0.015638128	0.008560780	0.004400417			
134.	K= 0	0.102235317	0.099268556	0.090814531	0.078113675	0.062934220	0.047208674	0.032664903
	K= 7	0.020543423	0.011456344	0.005406123	0.002052761			
135.	K= 0	0.109721124	0.106010497	0.095537961	0.080109715	0.062216237	0.044429876	0.028845884
	K= 7	0.016722627	0.008394841	0.003438700	0.001014005			

NO.	INDEX	HO(K)	HO(K+1)	HO(K+2)	HO(K+3)	HO(K+4)	HO(K+5)	HO(K+6)
136.	K= 0	0.116413057	0.111943543	0.099446595	0.081380308	0.061024934	0.041581418	0.025409244
	K= 7	0.013635397	0.006198816	0.002224745	0.000529308			
137.	K= 0	0.084798455	0.083198249	0.078541338	0.071260214	0.062007390	0.051575720	0.040801123
	K= 7	0.030466154	0.021215454	0.013499632	0.010035235			
138.	K= 0	0.094498694	0.092226267	0.085685372	0.075660408	0.063308418	0.049962293	0.036921773
	K= 7	0.025264740	0.015715752	0.008595612	0.004409716			
139.	K= 0	0.102979124	0.099987805	0.091464341	0.078660667	0.063360989	0.047514755	0.032864064
	K= 7	0.020658445	0.011513077	0.005428184	0.002057788			
140.	K= 0	0.110511422	0.106770933	0.096214890	0.080665290	0.062634289	0.044715606	0.029020648
	K= 7	0.016816005	0.008436590	0.003453000	0.001016836			
141.	K= 0	0.117244065	0.112739623	0.100145578	0.081940830	0.061432883	0.041848116	0.025563333
	K= 7	0.013712019	0.006230120	0.002234306	0.000530964			
142.	K= 0	0.186473966	0.173196912	0.137543917	0.090252995	0.044163290	0.009324048	-0.010044888
	K= 7	-0.015647210	-0.012770660	-0.007126689	-0.002628501			
143.	K= 0	0.196370065	0.180786610	0.139542699	0.086481273	0.037324928	0.003098190	-0.013184216
	K= 7	-0.015467390	-0.010751255	-0.005069576	-0.001446159			
144.	K= 0	0.205116570	0.187296450	0.140766263	0.082590818	0.031221196	-0.001794032	-0.015044309
	K= 7	-0.014680292	-0.008934371	-0.003637913	-0.000841998			
145.	K= 0	0.178276956	0.166948557	0.136090934	0.093917310	0.050753146	0.015529260	-0.006800439
	K= 7	-0.016020916	-0.015570138	-0.010374114	-0.005193003			
146.	K= 0	0.189679801	0.175937235	0.139079094	0.090318978	0.043021049	0.007571392	-0.011775382
	K= 7	-0.016938165	-0.013508610	-0.007429954	-0.002696465			
147.	K= 0	0.199689627	0.183577478	0.140987515	0.086346269	0.035983849	0.001258737	-0.014857188
	K= 7	-0.016611006	-0.011340927	-0.005282894	-0.001487567			
148.	K= 0	0.208551109	0.190138102	0.142122805	0.082267344	0.029707901	-0.003690423	-0.016646314
	K= 7	-0.015690390	-0.009407666	-0.003790146	-0.000867745			
149.	K= 0	0.180078387	0.168510437	0.137021422	0.094047487	0.050176270	0.014530774	-0.007876702
	K= 7	-0.016903996	-0.016136378	-0.010644060	-0.005264252			
150.	K= 0	0.191560626	0.177537799	0.139954746	0.090313137	0.042294413	0.006486967	-0.012835763
	K= 7	-0.017724745	-0.013956230	-0.007613122	-0.002737360			
151.	K= 0	0.201646566	0.185213923	0.141809285	0.086215496	0.035132121	0.000118346	-0.015883636
	K= 7	-0.017307587	-0.011697777	-0.005411081	-0.001512232			
152.	K= 0	0.210566759	0.191796839	0.142888606	0.082025945	0.028758377	-0.004859433	-0.017626856
	K= 7	-0.016305968	-0.009695124	-0.003882312	-0.000883286			
153.	K= 0	0.170282900	0.160770893	0.134481728	0.097447932	0.057637997	0.022619542	-0.002425785
	K= 7	-0.015734591	-0.018774159	-0.015103776	-0.011060987			

NO.	INDEX	HO(K)	HO(K+1)	HO(K+2)	HO(K+3)	HO(K+4)	HO(K+5)	HO(K+6)
154.	K= 0	0.183697999	0.171632886	0.138835788	0.094209850	0.048887689	0.012392644	-0.010145918
	K= 7	-0.018747214	-0.017308116	-0.011197515	-0.005408879			
155.	K= 0	0.195345283	0.180740833	0.141655743	0.090194345	0.040699285	0.004176322	-0.015069176
	K= 7	-0.019369438	-0.014886782	-0.007992037	-0.002821602			
156.	K= 0	0.205575585	0.188480079	0.143392742	0.085838497	0.033283394	-0.002301058	-0.018041011
	K= 7	-0.018762622	-0.012439057	-0.005675767	-0.001562841			
157.	K= 0	0.214623690	0.195113420	0.144355953	0.081416190	0.026703574	-0.007339325	-0.019688260
	K= 7	-0.017592192	-0.010292683	-0.004073005	-0.000915301			
158.	K= 0	0.273027658	0.236543775	0.146718621	0.048690405	-0.016885508	-0.036592379	-0.024595372
	K= 7	-0.005112521	0.005867019	0.006470565	0.002881336			
159.	K= 0	0.284232378	0.243030787	0.143555880	0.039731566	-0.023564290	-0.036594681	-0.020155661
	K= 7	-0.001241846	0.006627977	0.005244918	0.001748859			
160	K= 0	0.293980241	0.248381913	0.140230536	0.031878758	-0.028541684	-0.035643905	-0.016205918
	K= 7	0.001408436	0.006679289	0.004199650	0.001122558			
161.	K= 0	0.267165542	0.233600259	0.149607897	0.054594912	-0.013498962	-0.038508501	-0.029584832
	K= 7	-0.008709051	0.005992886	0.009022173	0.005481202			
162.	K= 0	0.280272722	0.241456330	0.146407306	0.044049941	-0.022298388	-0.039539970	-0.024286967
	K= 7	-0.002980001	0.007932290	0.007554054	0.003149794			
163.	K= 0	0.291640759	0.247882068	0.142828763	0.034726843	-0.028838761	-0.038959783	-0.019316565
	K= 7	0.000994361	0.008452203	0.006067786	0.001923388			
164.	K= 0	0.301534712	0.253171742	0.139132917	0.026589330	-0.033635899	-0.037490930	-0.014973100
	K= 7	0.003657222	0.008283053	0.004837953	0.001241030			
165.	K= 0	0.270800292	0.236116827	0.149564266	0.052300084	-0.016378947	-0.040267158	-0.029589999
	K= 7	-0.007527810	0.007328004	0.009837285	0.005716905			
166.	K= 0	0.284007788	0.243941724	0.146114886	0.041513417	-0.025127847	-0.040941864	-0.023911282
	K= 7	-0.001673474	0.009123925	0.008159950	0.003296239			
167.	K= 0	0.295452535	0.250326991	0.142316401	0.032011915	-0.031570580	-0.040035218	-0.018661402
	K= 7	0.002338793	0.009498995	0.006528206	0.002019197			
168.	K= 0	0.305413783	0.255578339	0.138429344	0.023739617	-0.036254622	-0.038284983	-0.014116619
	K= 7	0.004994642	0.009203013	0.005197145	0.001306813			
169.	K= 0	0.261818528	0.230963647	0.152485788	0.060486458	-0.009987220	-0.040594909	-0.035486430
	K= 7	-0.013545871	0.005714003	0.012690593	0.011364352			
170.	K= 0	0.277438998	0.240634859	0.149264395	0.047859702	-0.021718927	-0.043278798	-0.029194847
	K= 7	-0.004952170	0.010048408	0.011445630	0.006171834			
171.	K= 0	0.290820777	0.248389781	0.145347536	0.036644369	-0.030324806	-0.043244738	-0.022799920
	K= 7	0.001104176	0.011536375	0.009356190	0.003580247			

NO.	INDEX	HO(K)	HO(K+1)	HO(K+2)	HO(K+3)	HO(K+4)	HO(K+5)	HO(K+6)
172.	K= 0	0.302417457	0.254703522	0.141138196	0.026819061	-0.036561139	-0.041706562	-0.017028410
	K= 7	0.005165435	0.011615932	0.007439263	0.002205559			
173.	K= 0	0.312528968	0.259893775	0.136883914	0.018288624	-0.041017890	-0.039406478	-0.012102079
	K= 7	0.007791109	0.011061713	0.005907733	0.001434684			
174.	K= 0	0.362701654	0.283886731	0.112289250	-0.024488967	-0.058138400	-0.021853313	0.013704319
	K= 7	0.016839173	0.003284787	-0.004383687	-0.002990797			
175.	K= 0	0.374317825	0.287844300	0.104147673	-0.032958291	-0.056816068	-0.015043605	0.016456906
	K= 7	0.014234684	0.000722698	-0.004248075	-0.001999204			
176.	K= 0	0.384255588	0.290892780	0.096838653	-0.039598484	-0.054784711	-0.009451699	0.017843451
	K= 7	0.011803802	-0.000890696	-0.003871450	-0.001409511			
177.	K= 0	0.359288514	0.283594072	0.116161227	-0.022520959	-0.061609842	-0.026141766	0.014339425
	K= 7	0.021060355	0.005477753	-0.005991787	-0.005593959			
178.	K= 0	0.373108208	0.288509011	0.106578827	-0.033207942	-0.060568810	-0.017334044	0.018727098
	K= 7	0.017754234	0.001224033	-0.006261867	-0.003555840			
179.	K= 0	0.384853780	0.292216718	0.097919405	-0.041472159	-0.058301929	-0.010055829	0.020914052
	K= 7	0.014409266	-0.001429518	-0.005809557	-0.002398539			
180.	K= 0	0.394898951	0.295042872	0.090189695	-0.047874514	-0.055477139	-0.004185818	0.021761522
	K= 7	0.011440728	-0.003034242	-0.005188886	-0.001704903			
181.	K= 0	0.364254117	0.285862267	0.113493025	-0.026838940	-0.063011944	-0.023918021	0.017129861
	K= 7	0.021733396	0.004270136	-0.007298227	-0.006048635			
182.	K= 0	0.378146231	0.290636361	0.103606462	-0.037426375	-0.061406653	-0.014779087	0.021189932
	K= 7	0.017904043	-0.000098951	-0.007334962	-0.003863898			
183.	K= 0	0.389947891	0.294215024	0.094701707	-0.045558497	-0.058659982	-0.007306796	0.023042407
	K= 7	0.014178578	-0.002770133	-0.006699290	-0.002617048			
184.	K= 0	0.400035560	0.296925962	0.086777449	-0.051815365	-0.055437993	-0.001337548	0.023579933
	K= 7	0.010939684	-0.004345354	-0.005937796	-0.001866833			
185.	K= 0	0.356290817	0.283506870	0.119942904	-0.020752456	-0.065495729	-0.030996718	0.015099205
	K= 7	0.026555065	0.008784600	-0.008312911	-0.011476267			
186.	K= 0	0.372915983	0.289651692	0.108516216	-0.034377679	-0.064924479	-0.019422770	0.022067018
	K= 7	0.022374373	0.001516490	-0.009935111	-0.006923728			
187.	K= 0	0.386927247	0.294165909	0.098105013	-0.044732150	-0.062284466	-0.009763904	0.025427751
	K= 7	0.017572727	-0.003002909	-0.009492639	-0.004459009			
188.	K= 0	0.398845732	0.297523320	0.088772416	-0.052603457	-0.058680769	-0.002007271	0.026608814
	K= 7	0.013158146	-0.005659562	-0.008491695	-0.003042812			
189.	K= 0	0.409027040	0.300032318	0.080498993	-0.058580849	-0.054741237	0.004093539	0.026533060
	K= 7	0.009429105	-0.007145233	-0.007449135	-0.002184163			

NO.	INDEX	HO(K)	HO(K+1)	HO(K+2)	HO(K+3)	HO(K+4)	HO(K+5)	HO(K+6)
190.	K= 0	0.454066396	0.309175372	0.042027086	-0.081228316	-0.031971265	0.029354103	0.019745108
	K= 7	-0.008842133	-0.009366468	0.001540948	0.003032169			
191.	K= 0	0.465280652	0.309963822	0.031792339	-0.083196342	-0.024234816	0.031583522	0.014994126
	K= 7	-0.010491911	-0.007092107	0.002311778	0.002229048			
192.	K= 0	0.474623382	0.310308397	0.023270942	-0.084048688	-0.017818734	0.032529235	0.011111960
	K= 7	-0.011164591	-0.005321302	0.002600612	0.001720296			
193.	K= 0	0.452954173	0.310281456	0.043725319	-0.083912313	-0.034925502	0.032192647	0.023551043
	K= 7	-0.010653079	-0.012882374	0.002091136	0.005635332			
194.	K= 0	0.466533899	0.311331928	0.031156965	-0.086625814	-0.025003616	0.035503808	0.016965147
	K= 7	-0.013441525	-0.009305250	0.003772054	0.003960121			
195.	K= 0	0.477801800	0.311749756	0.020718813	-0.087697506	-0.016757701	0.036788590	0.011530910
	K= 7	-0.014485020	-0.006464615	0.004355565	0.002941075			
196.	K= 0	0.487171650	0.311783791	0.012078483	-0.087791741	-0.010032345	0.036919363	0.007224936
	K= 7	-0.014617529	-0.004331082	0.004471600	0.002289506			
197.	K= 0	0.458731115	0.311327636	0.038645916	-0.086590290	-0.031590156	0.035394881	0.022179484
	K= 7	-0.013256460	-0.012897562	0.003583613	0.006337039			
198.	K= 0	0.472340107	0.312167823	0.025954127	-0.088786364	-0.021341074	0.038139053	0.015123311
	K= 7	-0.015656825	-0.008884292	0.005136169	0.004477635			
199.	K= 0	0.483628333	0.312410295	0.015441082	-0.089419007	-0.012900326	0.038926791	0.009406015
	K= 7	-0.016341064	-0.005772196	0.005593803	0.003340096			
200.	K= 0	0.493021548	0.312297702	0.006748125	-0.089146197	-0.006057676	0.038639206	0.004931495
	K= 7	-0.016166873	-0.003468415	0.005601037	0.002610474			
201.	K= 0	0.451989353	0.311471999	0.045369808	-0.086888671	-0.038159743	0.035544980	0.028241988
	K= 7	-0.013012741	-0.017959718	0.002884407	0.011512686			
202.	K= 0	0.468583643	0.312866211	0.029777270	-0.090627491	-0.025260266	0.040489081	0.018932685
	K= 7	-0.017809141	-0.012167174	0.006790735	0.007715996			
203.	K= 0	0.482226491	0.313343465	0.016917072	-0.091903150	-0.014539544	0.042155504	0.011150524
	K= 7	-0.019380834	-0.007392354	0.008034918	0.005500831			
204.	K= 0	0.493545532	0.313282132	0.006301407	-0.091759086	-0.005832728	0.042016335	0.005017940
	K= 7	-0.019331947	-0.003815937	0.008213419	0.004135385			
205.	K= 0	0.502968907	0.312918186	-0.002449297	-0.090838730	0.001143451	0.040956050	0.000325886
	K= 7	-0.018541779	-0.001232467	0.007981192	0.003252774			
206.	K= 0	0.555918217	0.307095289	-0.050398096	-0.076231778	0.036618683	0.024139199	-0.020897832
	K= 7	-0.005484316	0.008831076	0.000310824	-0.002441987			
207.	K= 0	0.563915908	0.305205226	-0.056863666	-0.071851452	0.039722715	0.019900680	-0.021209389
	K= 7	-0.003081800	0.008167751	-0.000397511	-0.002050354			

NO.	INDEX	HO(K)	HO(K+1)	HO(K+2)	HO(K+3)	HO(K+4)	HO(K+5)	HO(K+6)
208.	K= 0	0.559465647	0.307679951	-0.054306462	-0.077459753	0.041108575	0.024983045	-0.025262777
	K= 7	-0.005431466	0.012053329	-0.000312248	-0.004366022			
209.	K= 0	0.569401860	0.305252612	-0.062401045	-0.071687996	0.045047704	0.019086219	-0.025529079
	K= 7	-0.001767282	0.010862578	-0.001594967	-0.003550699			
210.	K= 0	0.577356637	0.303088248	-0.068619668	-0.066727519	0.047541134	0.014401875	-0.025124941
	K= 7	0.000775848	0.009714387	-0.002303931	-0.003004713			
211.	K= 0	0.553217947	0.309606910	-0.049408048	-0.082158208	0.039343320	0.030022494	-0.026424494
	K= 7	-0.008765835	0.014437560	0.000835283	-0.006597813			
212.	K= 0	0.565613508	0.306804299	-0.059833113	-0.075243175	0.045103494	0.022376224	-0.027560543
	K= 7	-0.003322544	0.013122089	-0.001614723	-0.005138636			
213.	K= 0	0.575527430	0.304220319	-0.067785084	-0.069132090	0.048672754	0.016209163	-0.027361609
	K= 7	0.000427872	0.011578679	-0.002896106	-0.004197489			
214.	K= 0	0.583468735	0.301932275	-0.073884308	-0.063920736	0.050857760	0.011356782	-0.026592221
	K= 7	0.002990201	0.010174122	-0.003583426	-0.003564690			
215.	K= 0	0.563557684	0.308199883	-0.058848359	-0.078493118	0.046493229	0.025447492	-0.030864295
	K= 7	-0.004682422	0.016701937	-0.002181258	-0.008551858			
216.	K= 0	0.575921834	0.305061996	-0.068990707	-0.070824444	0.051461585	0.017145507	-0.030916363
	K= 7	0.001017471	0.014452808	-0.004650477	-0.006718155			
217.	K= 0	0.585791230	0.302218199	-0.076674342	-0.064173520	0.054341480	0.010599967	-0.029854238
	K= 7	0.004809674	0.012238298	-0.005875204	-0.005525798			
218.	K= 0	0.593714297	0.299722373	-0.082558513	-0.058556981	0.055962883	0.005521003	-0.028415751
	K= 7	0.007325768	0.010348585	-0.006487075	-0.004719328			
219.	K= 0	0.645175695	0.280184448	-0.116213381	-0.017934062	0.055727735	-0.024584588	-0.010059610
	K= 7	0.015734293	-0.004333571	-0.003229111	0.002619908			
220.	K= 0	0.651134610	0.277270257	-0.118949652	-0.013030712	0.053617746	-0.026261512	-0.007443491
	K= 7	0.014736619	-0.004886631	-0.002489621	0.002369553			
221.	K= 0	0.650966048	0.278691530	-0.121234596	-0.013663348	0.058069091	-0.029910974	-0.008787330
	K= 7	0.019133039	-0.007241596	-0.003709689	0.004751720			
222.	K= 0	0.658724964	0.274788439	-0.124671996	-0.007062506	0.054874614	-0.032030515	-0.004864231
	K= 7	0.017331313	-0.008026835	-0.002315214	0.004195385			
223.	K= 0	0.664597213	0.271728158	-0.127043009	-0.002152827	0.052207708	-0.033231657	-0.002099485
	K= 7	0.015848648	-0.008366033	-0.001426742	0.003817562			
224.	K= 0	0.646882772	0.281208754	-0.120204031	-0.017452534	0.061455682	-0.030042328	-0.011722010
	K= 7	0.022149876	-0.007751945	-0.005404230	0.006821170			
225.	K= 0	0.657076418	0.276181936	-0.124988437	-0.008563817	0.057423983	-0.033411901	-0.005991165
	K= 7	0.019729801	-0.009302910	-0.002936014	0.005820032			

NO.	INDEX	HO(K)	HO(K+1)	HO(K+2)	HO(K+3)	HO(K+4)	HO(K+5)	HO(K+6)
226.	K= 0	0.664789557	0.272190750	-0.128206253	-0.001965216	0.053887613	-0.035213616	-0.001991177
	K= 7	0.017592687	-0.009911899	-0.001433630	0.005155783			
227.	K= 0	0.670620143	0.269067824	-0.130406797	0.002925349	0.050977323	-0.036164567	0.000802765
	K= 7	0.015877273	-0.010110926	-0.000480835	0.004702330			
228.	K= 0	0.657105625	0.277001619	-0.126550555	-0.008713275	0.060309380	-0.036291748	-0.000650083
	K= 7	0.023189180	-0.011926506	-0.003476183	0.009408232			
229.	K= 0	0.667195737	0.271776855	-0.130842626	0.000171652	0.055480581	-0.038902961	-0.000581590
	K= 7	0.019907095	-0.012988340	-0.000702566	0.008083832			
230.	K= 0	0.674819589	0.267651081	-0.133686841	0.006719295	0.051402908	-0.040118005	0.003463208
	K= 7	0.017201684	-0.013211738	0.000966962	0.007201478			
231.	K= 0	0.680589199	0.264425755	-0.135604084	0.011556525	0.048103347	-0.040617954	0.006247249
	K= 7	0.015090611	-0.013110910	0.002020153	0.006594576			
232.	K= 0	0.731941760	0.233104944	-0.146737278	0.051653374	0.013251081	-0.034429982	0.024522170
	K= 7	-0.006294791	-0.004625909	0.005795635	-0.002709786			
233.	K= 0	0.735348105	0.230715334	-0.146657467	0.053576533	0.010805942	-0.032894254	0.024351548
	K= 7	-0.006984659	-0.003851263	0.005362101	-0.002597599			
234.	K= 0	0.739883006	0.228636086	-0.149451435	0.058762368	0.008028075	-0.034924712	0.029183920
	K= 7	-0.010578893	-0.003693797	0.007564619	-0.005048536			
235.	K= 0	0.744722307	0.225165367	-0.149159551	0.061399326	0.004380602	-0.032364659	0.028641958
	K= 7	-0.011566229	-0.002322709	0.006654739	-0.004770778			
236.	K= 0	0.748045027	0.222752869	-0.148873270	0.063102067	0.001936179	-0.030572850	0.028160181
	K= 7	-0.012118090	-0.001473031	0.006070413	-0.004587833			
237.	K= 0	0.738640070	0.229970157	-0.150695324	0.059142247	0.009212881	-0.037406508	0.031637233
	K= 7	-0.011575621	-0.004555367	0.009410318	-0.006959695			
238.	K= 0	0.745599210	0.224989116	-0.150334895	0.063081026	0.003753017	-0.033558611	0.030890524
	K= 7	-0.013271376	-0.002179422	0.007759783	-0.006428510			
239.	K= 0	0.750383198	0.221504807	-0.149908721	0.065565109	0.000121297	-0.030833654	0.030122500
	K= 7	-0.014135811	-0.000770060	0.006728571	-0.006085388			
240.	K= 0	0.753672481	0.219082952	-0.149535060	0.067166150	-0.002308727	-0.028939199	0.029493548
	K= 7	-0.014602680	0.000100198	0.006067753	-0.005860928			
241.	K= 0	0.748130918	0.223842263	-0.152025700	0.066348612	0.001756774	-0.034698743	0.034420997
	K= 7	-0.016570058	-0.001305400	0.009368442	-0.010202289			
242.	K= 0	0.754971206	0.218824089	-0.151342928	0.069917023	-0.003654522	-0.030447446	0.033080239
	K= 7	-0.017909549	0.001148085	0.007365845	-0.009466082			
243.	K= 0	0.759670317	0.215320408	-0.150703371	0.072141349	-0.007232264	-0.027473852	0.031925686
	K= 7	-0.018524118	0.002586410	0.006115206	-0.008990306			

NO.	INDEX	HO(K)	HO(K+1)	HO(K+2)	HO(K+3)	HO(K+4)	HO(K+5)	HO(K+6)
244.	K= 0	0.762879312	0.212900043	-0.150184512	0.073552430	-0.009603944	-0.025430553	0.031039495
	K= 7	-0.018808987	0.003461120	0.005312018	-0.008676451			
245.	K= 0	0.815339565	0.171639025	-0.136649549	0.090170264	-0.044752620	0.010260690	0.009108003
	K= 7	-0.014941797	0.012363646	-0.006957371	0.002589728			
246.	K= 0	0.816355705	0.170763969	-0.136140406	0.090109766	-0.045065757	0.010769274	0.008595403
	K= 7	-0.014554240	0.012139339	-0.006863974	0.002568568			
247.	K= 0	0.824797809	0.164271593	-0.134464979	0.093626559	-0.051647421	0.017139234	0.005044460
	K= 7	-0.014570743	0.014635619	-0.009926289	0.005073864			
248.	K= 0	0.826521158	0.162764907	-0.133530617	0.093422055	-0.052096412	0.017989628	0.004102513
	K= 7	-0.013785973	0.014125552	-0.009679385	0.005007856			
249.	K= 0	0.827505887	0.161902189	-0.132990420	0.093293667	-0.052337229	0.018458571	0.003579143
	K= 7	-0.013348214	0.013840307	-0.009540956	0.004970729			
250.	K= 0	0.834879637	0.156218529	-0.131569386	0.096699238	-0.058953006	0.025370967	-0.000872895
	K= 7	-0.012719009	0.016575500	-0.013860501	0.010670338			
251.	K= 0	0.837788105	0.153635263	-0.129864275	0.096160829	-0.059538916	0.026756234	-0.002587284
	K= 7	-0.011123396	0.015393514	-0.013179176	0.010452699			
252.	K= 0	0.839438140	0.152165473	-0.128881216	0.095825493	-0.059829194	0.027493641	-0.003513161
	K= 7	-0.010256723	0.014749564	-0.012807176	0.010333780			
253.	K= 0	0.840365708	0.151337743	-0.128323197	0.095626354	-0.059977446	0.027891736	-0.004018515
	K= 7	-0.009780426	0.014393616	-0.012600616	0.010267481			
254.	K= 0	0.898072243	0.098970652	-0.090545177	0.077886581	-0.062756658	0.047080681	-0.032581031
	K= 7	0.020494517	-0.011431996	0.005396366	-0.002050078			
255.	K= 0	0.898095787	0.098947942	-0.090524614	0.077869296	-0.062743187	0.047071002	-0.032574724
	K= 7	0.020490877	-0.011430208	0.005395662	-0.002049912			
256.	K= 0	0.906412423	0.091340184	-0.084872484	0.074958205	-0.062740028	0.049533624	-0.036624067
	K= 7	0.025077853	-0.015613087	0.008549314	-0.004396815			
257.	K= 0	0.906481802	0.091272771	-0.084810674	0.074904859	-0.062696874	0.049501121	-0.036601510
	K= 7	0.025063690	-0.015605271	0.008545745	-0.004395839			
258.	K= 0	0.906503737	0.091251433	-0.084791124	0.074888051	-0.062683225	0.049490791	-0.036594309
	K= 7	0.025059190	-0.015602864	0.008544713	-0.004395574			
259.	K= 0	0.915837824	0.082576334	-0.077961981	0.070746362	-0.061575390	0.051232927	-0.040546514
	K= 7	0.030291583	-0.021108013	0.013443053	-0.010017231			
260.	K= 0	0.916039169	0.082379639	-0.077778816	0.070583999	-0.061438680	0.051124513	-0.040466022
	K= 7	0.030236289	-0.021074027	0.013425242	-0.010011654			
261.	K= 0	0.916102827	0.082317472	-0.077720881	0.070532620	-0.061395481	0.051090229	-0.040440548
	K= 7	0.030218832	-0.021063268	0.013419610	-0.010009918			

NO.	INDEX	HO(K)	HO(K+1)	HO(K+2)	HO(K+3)	HO(K+4)	HO(K+5)	HO(K+6)
262.	K= 0	0.916122913	0.082297862	-0.077702582	0.070516348	-0.061381809	0.051079404	-0.040432516
	K= 7	0.030213319	-0.021059848	0.013417795	-0.010009356			
263.	K= 0	0.133596301	0.128605902	0.114475787	0.093532681	0.069054425	0.044548180	0.023035008
	K= 7	0.006523065	-0.004219957	-0.009575725	-0.010738846	-0.009264272	-0.006639469	-0.003985394
	K= 14	-0.001936038	-0.000713394					
264.	K= 0	0.140296638	0.134487271	0.118152559	0.094284356	0.067004025	0.040553000	0.018349480
	K= 7	0.002372125	-0.006997891	-0.010701656	-0.010451593	-0.008118384	-0.005246710	-0.002806214
	K= 14	-0.001183119	-0.000345458					
265.	K= 0	0.128431380	0.124100327	0.111755252	0.093207896	0.071066678	0.048226621	0.027335368
	K= 7	0.010360047	-0.001663252	-0.008656710	-0.011330698	-0.010881998	-0.008651927	-0.005830862
	K= 14	-0.003267692	-0.001565807					
266.	K= 0	0.135889351	0.130724609	0.116109788	0.094475508	0.069241285	0.044056326	0.022050004
	K= 7	0.005283125	-0.005483314	-0.010684852	-0.011594288	-0.009844165	-0.006980017	-0.004152730
	K= 14	-0.001999594	-0.000727371					
267.	K= 0	0.142683327	0.136675060	0.119791627	0.095154703	0.067057610	0.039906681	0.017234895
	K= 7	0.001062769	-0.008257750	-0.011745587	-0.011207454	-0.008595359	-0.005504470	-0.002920920
	K= 14	-0.001221649	-0.000352850					
268.	K= 0	0.123874485	0.120125294	0.109368265	0.092990160	0.073030829	0.051833220	0.031663880
	K= 7	0.014374483	0.001162795	-0.007522378	-0.011932254	-0.012852501	-0.011367358	-0.008613575
	K= 14	-0.005572807	-0.003625112					
269.	K= 0	0.132323861	0.127714157	0.114588201	0.094909728	0.071498156	0.047469568	0.025654711
	K= 7	0.008128729	-0.004052326	-0.010869309	-0.013143532	-0.012199979	-0.009492591	-0.006287389
	K= 14	-0.003464523	-0.001615434					
270.	K= 0	0.139952302	0.134464025	0.118950248	0.096037149	0.069409609	0.042982217	0.020085033
	K= 7	0.002874599	-0.007904358	-0.012791377	-0.013207469	-0.010930695	-0.007613979	-0.004462101
	K= 14	-0.002116142	-0.000752756					
271.	K= 0	0.146902025	0.140525460	0.122627199	0.096571863	0.066974282	0.038547676	0.015036732
	K= 7	-0.001463740	-0.010660410	-0.013720594	-0.012628309	-0.009486698	-0.005983301	-0.003132629
	K= 14	-0.001292206	-0.000366259					
272.	K= 0	0.185109138	0.173435390	0.141429365	0.097110093	0.050840486	0.012067806	-0.013306297
	K= 7	-0.024049290	-0.023009531	-0.015294690	-0.006103564	0.000925942	0.004366245	0.004663650
	K= 14	0.003228602	0.001640939					
273.	K= 0	0.180257261	0.169694364	0.140493333	0.099358320	0.055196673	0.016558647	-0.010595493
	K= 7	-0.024111569	-0.025554668	-0.019017942	-0.009393524	-0.000764942	0.004562728	0.006204050
	K= 14	0.005162198	0.003660005					
274.	K= 0	0.175943851	0.166369438	0.139689863	0.101480007	0.059347771	0.020959713	-0.007808194

NO.	INDEX	H0(K)	H0(K+1)	H0(K+2)	H0(K+3)	H0(K+4)	H0(K+5)	H0(K+6)
	K= 7	-0.024081070	-0.028237998	-0.023273546	-0.013524484	-0.003267279	0.004406653	0.008128885
	K= 14	0.008154385	0.008683506					
275.	K= 0	0.246232212	0.220517635	0.153784633	0.071904659	0.003303357	-0.034028701	-0.038643815
	K= 7	-0.022553731	-0.002184564	0.010585696	0.012521692	0.007357482	0.001011230	-0.002595864
	K= 14	-0.002908588	-0.001687110					
276.	K= 0	0.255950034	0.227045059	0.153025508	0.064858675	-0.004958611	-0.038237680	-0.036936123
	K= 7	-0.017188419	0.002743543	0.012272734	0.010993510	0.004655682	-0.000802376	-0.002835356
	K= 14	-0.002211313	-0.000899697					
277.	K= 0	0.264719546	0.232731462	0.151834846	0.058147263	-0.012074526	-0.041041017	-0.034459680
	K= 7	-0.012232464	0.006399482	0.012766667	0.009135965	0.002509438	-0.001807280	-0.002653996
	K= 14	-0.001613538	-0.000502264					
278.	K= 0	0.242657483	0.218386054	0.154847145	0.075410128	0.006600790	-0.033431895	-0.041203458
	K= 7	-0.026434001	-0.004721727	0.010925874	0.015192438	0.010378312	0.002528346	-0.003099487
	K= 14	-0.004572239	-0.003716040					
279.	K= 0	0.253703296	0.225930393	0.154275954	0.067538798	-0.003153480	-0.038975995	-0.039820284
	K= 7	-0.020109858	0.001857168	0.013866898	0.013729762	0.006638516	-0.000588363	-0.004026994
	K= 14	-0.003692963	-0.001902261					
280.	K= 0	0.263588428	0.232427120	0.153116286	0.059999179	-0.011513211	-0.042656519	-0.037238557
	K= 7	-0.014108494	0.006771214	0.014960498	0.011478003	0.003524422	-0.002376741	-0.003993481
	K= 14	-0.002742657	-0.001022259					
281.	K= 0	0.272507608	0.238075435	0.151552200	0.052866802	-0.018642515	-0.044913772	-0.033995196
	K= 7	-0.008709829	0.010262221	0.014867224	0.009054057	0.001151392	-0.003270620	-0.003577838
	K= 14	-0.001979472	-0.000574886					
282.	K= 0	0.239581347	0.216588855	0.155901074	0.078666091	0.009646058	-0.032973804	-0.043894384
	K= 7	-0.030580062	-0.007580388	0.011225540	0.018389765	0.014369190	0.004879367	-0.003549486
	K= 14	-0.007132199	-0.008746088					
283.	K= 0	0.252351403	0.225443900	0.155548751	0.069705546	-0.002045357	-0.040264238	-0.042973813
	K= 7	-0.023015458	0.001284069	0.016080108	0.017236348	0.009155490	-0.000493777	-0.006095067
	K= 14	-0.006441317	-0.004300747					
284.	K= 0	0.263649285	0.232947528	0.154379249	0.061072521	-0.011982962	-0.045014165	-0.040187363
	K= 7	-0.015586544	0.007924832	0.018025555	0.014408037	0.004511278	-0.003674459	-0.006480630
	K= 14	-0.004941922	-0.002225441					
285.	K= 0	0.273751318	0.239385009	0.152661562	0.052894436	-0.020372901	-0.047850784	-0.036372125
	K= 7	-0.008827876	0.012592789	0.018090997	0.011076678	0.000893328	-0.005291946	-0.005955521
	K= 14	-0.003590565	-0.001208572					
286.	K= 0	0.282875419	0.244973421	0.150577009	0.045213938	-0.027434804	-0.049264573	-0.032063887

NO.	INDEX	HO(K)	HO(K+1)	HO(K+2)	HO(K+3)	HO(K+4)	HO(K+5)	HO(K+6)
	K= 7	-0.002939190	0.015660688	0.017030410	0.007834177	-0.001718146	-0.005920392	-0.005134482
	K= 14	-0.002565475	-0.000686265					
287.	K= 0	0.308779955	0.260310650	0.143348217	0.022501085	-0.046547461	-0.050547667	-0.017193597
	K= 7	0.014169548	0.022052482	0.010681745	-0.003324260	-0.008476932	-0.005080521	0.000151210
	K= 14	0.002355053	0.001710234					
288.	K= 0	0.306280375	0.259418249	0.145356596	0.025189895	-0.046398740	-0.053436778	-0.020230558
	K= 7	0.014135342	0.025070321	0.013760243	-0.003004823	-0.010828387	-0.007602535	-0.000399926
	K= 14	0.003669405	0.003742312					
289.	K= 0	0.304174721	0.258738041	0.147240341	0.027601801	-0.046444058	-0.056420658	-0.023335468
	K= 7	0.014177442	0.028498050	0.017421119	-0.002518167	-0.013847403	-0.011217434	-0.001444651
	K= 14	0.005689353	0.008774016					
290.	K= 0	0.372159660	0.290420651	0.110570014	-0.035061337	-0.068989515	-0.021563400	0.025602981
	K= 7	0.027497273	0.001584526	-0.014681816	-0.009370465	0.002542454	0.006172009	0.002068202
	K= 14	-0.001649409	-0.001722050					
291.	K= 0	0.382784009	0.294062257	0.102793694	-0.043556955	-0.067549348	-0.013394944	0.029453953
	K= 7	0.023409024	-0.003674633	-0.014749106	-0.005883764	0.004395418	0.005048458	0.005561897
	K= 14	-0.001751324	-0.001056708					
292.	K= 0	0.392224848	0.297008693	0.095548034	-0.050591394	-0.065298140	-0.006207824	0.031655088
	K= 7	0.019133661	-0.007514570	-0.013801590	-0.002971095	0.005208842	0.003833211	-0.000346720
	K= 14	-0.001589969	-0.000678715					
293.	K= 0	0.370569944	0.290390968	0.112542927	-0.034315277	-0.071239471	-0.023916110	0.026691560
	K= 7	0.030876134	0.002814989	-0.017158777	-0.012231290	0.002773522	0.008693203	0.003523635
	K= 14	-0.002556976	-0.003755229					
294.	K= 0	0.382753074	0.294650912	0.103657722	-0.044347279	-0.069822669	-0.014124598	0.031776275
	K= 7	0.025998320	-0.004234903	-0.017667431	-0.007369820	0.005876373	0.007170141	0.000793755
	K= 14	-0.003093916	-0.002220655					
295.	K= 0	0.393473327	0.298024714	0.095389605	-0.052519742	-0.067259967	-0.005533341	0.034573279
	K= 7	0.020683859	-0.009307902	-0.016498141	-0.003229166	0.007206030	0.005277332	-0.000854517
	K= 14	-0.002891395	-0.001378514					
296.	K= 0	0.403002083	0.300726950	0.087726116	-0.059203852	-0.064028740	0.001867268	0.035748370
	K= 7	0.015498687	-0.012747981	-0.014505863	0.000000963	0.007454839	0.003526652	-0.001758924
	K= 14	-0.002492017	-0.000894691					
297.	K= 0	0.369252086	0.290464103	0.114355147	-0.033770923	-0.073569298	-0.026242036	0.027957350
	K= 7	0.034596644	0.004188366	-0.020114802	-0.015838735	0.003004334	0.012236074	0.005849592
	K= 14	-0.003955077	-0.008786771					
298.	K= 0	0.383356452	0.295480728	0.104086280	-0.045711715	-0.072165728	-0.014371067	0.034654655

NO.	INDEX	HO(K)	HO(K+1)	HO(K+2)	HO(K+3)	HO(K+4)	HO(K+5)	HO(K+6)
	K= 7	0.028676394	-0.005349714	-0.021327592	-0.008946985	0.008201603	0.010184418	0.007679€8
	K= 14	-0.005850613	-0.005006887					
299.	K= 0	0.395670533	0.299365878	0.094511271	-0.055282965	-0.069130898	-0.003958747	0.038150482
	K= 7	0.021893878	-0.012097783	-0.019751959	-0.002921857	0.010316581	0.007076427	-0.002327364
	K= 14	-0.005672917	-0.003005340					
300.	K= 0	0.406526685	0.302405894	0.085655630	-0.062960625	-0.065169692	0.004919156	0.039394286
	K= 7	0.015205678	-0.016479682	-0.016833443	0.001724599	0.010544792	0.004100434	-0.003968995
	K= 14	-0.004909858	-0.001891466					
301.	K= 0	0.416176081	0.304801166	0.077496946	-0.069123030	-0.060728904	0.012363084	0.039109055
	K= 7	0.009070799	-0.019032259	-0.013438478	0.005035091	0.009747293	0.001641179	-0.004702516
	K= 14	-0.004084174	-0.001243359					
302.	K= 0	0.435977757	0.309152603	0.060143854	-0.080654860	-0.049702432	0.027222563	0.035751261
	K= 7	-0.004695736	-0.021907598	-0.003902810	0.010966208	0.005251121	-0.004087999	-0.003601064
	K= 14	0.000847815	0.001727990					
303.	K= 0	0.435211778	0.309634924	0.061325584	-0.081761003	-0.051859785	0.028148070	0.038805481
	K= 7	-0.004687537	-0.025192823	-0.005088948	0.013646819	0.007237412	-0.005643282	-0.005664036
	K= 14	0.001312017	0.003761936					
304.	K= 0	0.434577107	0.310144842	0.062406678	-0.082952976	-0.054027315	0.029193535	0.042085055
	K= 7	-0.004718348	-0.028978571	-0.006514218	0.017010733	0.009908240	-0.007811114	-0.008855604
	K= 14	0.002026003	0.008794077					
305.	K= 0	0.499997258	0.315508246	0.000002561	-0.097938836	-0.000002264	0.050817627	0.000001970
	K= 7	-0.028967578	-0.000001400	0.016406264	0.000000978	-0.008742072	-0.000000603	0.004146107
	K= 14	0.000000320	-0.001729626					
306.	K= 0	0.510308027	0.315040171	-0.009874757	-0.096637309	0.008664932	0.048959829	-0.006922066
	K= 7	-0.026922382	0.004974242	0.014528766	-0.003144634	-0.007283505	0.001674850	0.003206448
	K= 14	-0.000697337	-0.001220891					
307.	K= 0	0.519241154	0.314361513	-0.018333845	-0.094782948	0.015829884	0.046405043	-0.012308579
	K= 7	-0.024261214	0.008514024	0.012271769	-0.005122073	-0.005713739	0.002564561	0.002343344
	K= 14	-0.000989387	-0.000898546					
308.	K= 0	0.499998271	0.316159308	0.000001500	-0.099786937	-0.000001409	0.053571522	0.000001222
	K= 7	-0.032213744	-0.000000915	0.019691121	0.000000788	-0.011663131	-0.000000498	0.006424349
	K= 14	0.000000376	-0.003763496					
309.	K= 0	0.511981726	0.315627277	-0.011575662	-0.098284304	0.010424756	0.051357780	-0.008711156
	K= 7	-0.029649381	0.006696824	0.017160807	-0.004663613	-0.009490918	0.002863990	0.004807897
	K= 14	-0.001566387	-0.002569542					
310.	K= 0	0.522287130	0.314804733	-0.021403365	-0.096003175	0.018929388	0.048115134	-0.015347768

NO.	INDEX		HO(K)	HO(K+1)	HO(K+2)	HO(K+3)	HO(K+4)	HO(K+5)	HO(K+6)
	K=	7	-0.026102867	0.011307463	0.013934445	-0.007452171	-0.007013828	0.004276101	0.003232476
	K=	14	-0.002164536	-0.001836349					
311.	K=	0	0.531224072	0.313819826	-0.029793870	-0.093316257	0.025848113	0.044424038	-0.020299613
	K=	7	-0.022270218	0.014312010	0.010689124	-0.008929200	-0.004745793	0.004815664	0.001950523
	K=	14	-0.002330552	-0.001366655					
312.	K=	0	0.499959344	0.316812038	0.000000425	-0.101671875	-0.000000404	0.056479964	0.000000467
	K=	7	-0.035826437	-0.000000350	0.023632310	0.000000378	-0.015549965	-0.000000323	0.009920262
	K=	14	0.000000231	-0.008795973					
313.	K=	0	0.514057159	0.316200435	-0.013698570	-0.099916160	0.012663908	0.053804889	-0.011077862
	K=	7	-0.032567143	0.009123754	0.020175263	-0.007017870	-0.012263428	0.005009748	0.007081535
	K=	14	-0.003740940	-0.005805772					
314.	K=	0	0.526042461	0.315181971	-0.025205627	-0.097048044	0.022831216	0.049597971	-0.019299101
	K=	7	-0.027729150	0.015146807	0.015441403	-0.010948323	-0.008230571	0.007241067	0.004062936
	K=	14	-0.005037110	-0.004026301					
315.	K=	0	0.536359310	0.313942850	-0.034928638	-0.093620002	0.030937452	0.044751186	-0.025196631
	K=	7	-0.022461705	0.018781587	0.010671172	-0.012730431	-0.004552089	0.007834192	0.001608384
	K=	14	-0.005297981	-0.002918548					
316.	K=	0	0.545305669	0.312598407	-0.043187995	-0.089966118	0.037381735	0.039775658	-0.029300634
	K=	7	-0.017354727	0.020715177	0.006392024	-0.013157010	-0.001555820	0.007557344	-0.000214816
	K=	14	-0.005136315	-0.002199403					
317.	K=	0	0.636570454	0.286692739	-0.115847468	-0.027272388	0.067402601	-0.026959330	-0.020120289
	K=	7	0.027553398	-0.005712077	-0.011723086	0.010025784	0.000244031	-0.005010992	0.002527435
	K=	14	0.000806205	-0.001391662					
318.	K=	0	0.643813014	0.283435941	-0.119924784	-0.020762365	0.065499663	-0.030871235	-0.015437223
	K=	7	0.026864130	-0.008583475	-0.009114549	0.009991508	-0.001290578	-0.003970996	0.002627937
	K=	14	0.000293725	-0.001164142					
319.	K=	0	0.639889717	0.285877705	-0.118855596	-0.024782345	0.069134057	-0.030627687	-0.019524340
	K=	7	0.030773118	-0.008431844	-0.012809187	0.013088420	-0.000877785	-0.006644465	0.004354879
	K=	14	0.000748253	-0.002949088					
320.	K=	0	0.648534417	0.281915486	-0.123641789	-0.016840424	0.066539705	-0.035323460	-0.013411313
	K=	7	0.029535234	-0.012160402	-0.008968066	0.012767013	-0.003185759	-0.004789583	0.004406258
	K=	14	-0.000282444	-0.002408730					
321.	K=	0	0.655705571	0.278470933	-0.127305508	-0.010252353	0.063840032	-0.038589124	-0.008345194
	K=	7	0.027818434	-0.014565825	-0.005802050	0.011939712	-0.004588395	-0.003292853	0.004160468
	K=	14	-0.000888760	-0.002033333					
322.	K=	0	0.643384635	0.284963369	-0.121981919	-0.022007033	0.070795715	-0.034689825	-0.018516406

NO.	INDEX	HO(K)	HO(K+1)	HO(K+2)	HO(K+3)	HO(K+4)	HO(K+5)	HO(K+6)
	K= 7	0.034265663	-0.011938833	-0.013674874	0.017000888	-0.002912354	-0.008583799	0.007464189
	K= 14	-0.000177559	-0.006699435					
323.	K= 0	0.653742075	0.280120194	-0.127607644	-0.012280803	0.067255080	-0.040311716	-0.010500472
	K= 7	0.032150563	-0.016759984	-0.007978614	0.016066428	-0.006383181	-0.005211584	0.007270310
	K= 14	-0.002362972	-0.005336560					
324.	K= 0	0.662289143	0.275900364	-0.131806016	-0.004270736	0.063541949	-0.043989580	-0.003943726
	K= 7	0.029344901	-0.019582201	-0.003380531	0.014324933	-0.008245461	-0.002559448	0.006471727
	K= 14	-0.003541072	-0.004409578					
325.	K= 0	0.669371307	0.272253036	-0.134973407	0.002313276	0.059972133	-0.046351120	0.001318343
	K= 7	0.026427746	-0.021109320	0.000173325	0.012406785	-0.009130988	-0.000593418	0.005548894
	K= 14	-0.004181772	-0.003759067					
326.	K= 0	0.818366468	0.170473576	-0.139824390	0.097227156	-0.052468535	0.014546823	0.010802466
	K= 7	-0.022206727	0.022166427	-0.015400484	0.006832097	-0.000011893	-0.003549397	0.004127819
	K= 14	-0.002970987	0.001572529					
327.	K= 0	0.820749760	0.168431938	-0.138686955	0.097243309	-0.053508963	0.016183995	0.009113081
	K= 7	-0.020924859	0.021528348	-0.015388958	0.007245366	-0.000583919	-0.003036701	0.003785479
	K= 14	-0.002804033	0.001527730					
328.	K= 0	0.824621379	0.165498078	-0.138120532	0.099355221	-0.057366364	0.020083498	0.006830890
	K= 7	-0.021129698	0.023973487	-0.018927634	0.010435298	-0.002348008	-0.003008759	0.005048994
	K= 14	-0.004514184	0.003459678					
329.	K= 0	0.827978969	0.162589610	-0.136413693	0.099222004	-0.058701392	0.022373024	0.004306767
	K= 7	-0.019045729	0.022757698	-0.018673945	0.010942221	-0.003253418	-0.002070685	0.004328784
	K= 14	-0.004098915	0.003328856					
330.	K= 0	0.830281973	0.160585046	-0.135209203	0.099069893	-0.059541192	0.023874201	0.002614585
	K= 7	-0.017610770	0.021874122	-0.018419512	0.011200018	-0.003794063	-0.001486490	0.003868691
	K= 14	-0.003827264	0.003241613					
331.	K= 0	0.830917358	0.160419941	-0.136201560	0.101262152	-0.062258288	0.025996637	0.002138712
	K= 7	-0.019282050	0.025383238	-0.022745099	0.015016556	-0.005993340	-0.001378254	0.005560037
	K= 14	-0.006449632	0.008071791					
332.	K= 0	0.835614979	0.156305730	-0.133669734	0.100853801	-0.063926578	0.029153876	-0.001585569
	K= 7	-0.015948258	0.023161002	-0.021947164	0.015525389	-0.007377144	0.000321525	0.004035112
	K= 14	-0.005383465	0.007673547					
333.	K= 0	0.838844836	0.153457046	-0.131861031	0.100452781	-0.064921498	0.031180486	-0.004055075
	K= 7	-0.013659220	0.021538846	-0.021228433	0.015667658	-0.008125413	0.001328051	0.003089148
	K= 14	-0.004698392	0.007412158					
334.	K= 0	0.841054380	0.151500762	-0.130593956	0.100122154	-0.065527260	0.032494467	-0.005696490

NO.	INDEX	HO(K)	HO(K+1)	HO(K+2)	HO(K+3)	HO(K+4)	HO(K+5)	HO(K+6)
	K= 7	-0.012103964	0.020397373	-0.C20667449	0.015674468	-0.008546967	0.001943242	0.C02488408
	K= 14	-0.004249506	0.007237103					
335.	K= 0	0.125753760	0.122222722	0.112021685	0.096271336	0.076661885	0.055216115	0.034016185
	K= 7	0.014934935	-0.000586707	-0.011682998	-0.018113803	-0.020219199	-0.C18797047	-0.014927939
	K= 14	-0.009782515	-0.004443798	0.000229851	0.003684403	0.005688716	0.006298024	0.005779169
	K= 21	0.004516490	0.002918420	0.C01341247	C.000039841	-0.000851099	-0.001309131	-0.C01396957
	K= 28	-0.001226053	-0.000920469	-C.000588298	-0.000371887			
336.	K= C	0.130699217	0.126724839	0.115281820	0.097735465	0.076124370	C.05285101C	C.C3032910l
	K= 7	0.010649338	-0.004681453	-0.014889166	-0.019953474	-0.020509042	-0.017656513	-0.012725919
	K= 14	-0.C07C38537	-0.001709283	0.002482899	0.005144410	0.006241564	0.0C6C18203	0.C04883118
	K= 21	0.003293951	0.001660330	0.CC0280525	-0.000683832	-0.001199230	-0.001328448	-0.001188028
	K= 28	-0.000907010	-0.000595717	-0.000328519	-0.000156387			
337.	K= C	0.124214649	0.12C861888	0.111156285	0.096108258	0.07725209C	0.056443766	0.035624739
	K= 7	0.016583506	0.000751294	-0.010940816	-0.018126979	-C.020991299	-0.020178020	-0.016648743
	K= 14	-0.011515543	-0.005870126	-0.000644210	0.003491396	0.006170113	0.007323228	C.C07128693
	K= 21	0.005932365	0.004157469	0.002219999	0.000462092	-0.000887510	-0.001725469	-0.002061332
	K= 28	-0.001987761	-0.001642814	-0.C01172642	-C.00C962277			
338.	K= C	0.129651070	0.125827372	0.114797890	0.097821593	0.076790452	0.053956494	C.031617019
	K= 7	0.011809438	-0.003937531	-0.014757764	-0.020492688	-0.021625981	-0.019130692	-0.014261458
	K= 14	-0.008332167	-0.002517058	0.002295997	0.00558200G	0.007184166	0.007257823	0.C06174337
	K= 21	0.004407689	0.002428252	0.000621058	-0.000761719	-0.001612229	-0.001948670	-0.C01877036
	K= 28	-0.001545983	-0.C01105314	-0.000675677	-C.00C396286			
339.	K= 0	0.134704113	0.130406082	0.118050873	0.099168241	0.07603412G	0.051314723	C.027662702
	K= 7	0.007339690	-0.008073002	-0.C17831057	-0.022034686	-0.021499984	-0.017530609	-0.C11641312
	K= 14	-0.005287796	0.000349213	0.004496481	0.006826051	0.007408056	0.0066C2805	C.004924301
	K= 21	0.C02906590	0.000998766	-0.000497581	-0.001445927	-0.001854375	-0.001831375	-C.C01533058
	K= 28	-0.001115985	-0.000704169	-0.000373520	-0.000167435			
340.	K= 0	0.123185992	0.119970560	0.110644996	0.096133232	0.077845037	0.057502061	0.036933526
	K= 7	0.017860509	0.001706814	-0.010541022	-0.018409744	-0.021947231	-0.021661926	-0.C18406052
	K= 14	-0.013231475	-0.007235620	-0.001411818	0.00345939C	0.006874297	0.008635320	C.C08814547
	K= 21	0.C07702585	0.005720504	0.003335197	C.000978998	-0.001009538	-0.002420083	-0.003177444
	K= 28	-0.003325401	-0.002994173	-0.002360768	-0.002578215			
341.	K= 0	0.129255056	0.125528455	0.114762068	0.098137796	0.077441394	0.054818124	0.032485675
	K= 7	0.012450945	-0.003727939	-0.015103132	-0.021397691	-0.022968501	-0.020684648	-0.015741765
	K= 14	-0.009456437	-0.003064650	0.002436337	0.006390002	0.008513942	0.008869924	0.C07785667
	K= 21	0.005748089	0.003291006	0.000896892	-0.00107321C	-0.002413991	-0.003075587	-0.003135339

NO.	INDEX	HO(K)	HO(K+1)	HO(K+2)	HO(K+3)	HO(K+4)	HO(K+5)	HO(K+6)
	K= 28	-0.002753370	-0.002122557	-0.001424778	-0.001040291			
342.	K= 0	0.134840429	0.130599201	0.118390918	0.099681854	0.076664805	0.051929921	0.028085839
	K= 7	0.007400200	-0.008487519	-0.018734265	-0.023325089	-0.022974025	-0.018923171	-0.012683563
	K= 14	-0.005768061	0.000536769	0.005327277	0.008150417	0.008984435	0.008149803	0.006178945
	K= 21	0.003675109	0.001188680	-0.000869732	-0.002270352	-0.002961471	-0.003032901	-0.002661106
	K= 28	-0.002050973	-0.001387274	-0.000804020	-0.000430922			
343.	K= 0	0.140039504	0.135279596	0.121626973	0.100857317	0.075599790	0.048907932	0.023779243
	K= 7	0.002711585	-0.012626778	-0.021561544	-0.024395473	-0.022230279	-0.016675729	-0.009512629
	K= 14	-0.002376199	0.003483852	0.007334590	0.008974601	0.008649904	0.006904583	0.004408102
	K= 21	0.001797710	-0.000435691	-0.002004967	-0.002828515	-0.002989391	-0.002671295	-0.002091165
	K= 28	-0.001444017	-0.000869221	-0.000439623	-0.000183060			
344.	K= 0	0.182197928	0.172047913	0.143713355	0.102994978	0.057901986	0.016667008	-0.014183912
	K= 7	-0.031189166	-0.034407277	-0.026922509	-0.013629612	0.000287597	0.010726966	0.015522234
	K= 14	0.014617313	0.009622395	0.002978091	-0.002947382	-0.006554574	-0.007323217	-0.005724818
	K= 21	-0.002843407	0.000110388	0.002213906	0.003054993	0.002733588	0.001693451	0.000481608
	K= 28	-0.000463396	-0.000928586	-0.000931883	-0.000916933			
345.	K= 0	0.180784762	0.170946121	0.143414795	0.103653550	0.059264954	0.018176753	-0.013162959
	K= 7	-0.031109776	-0.035350293	-0.028558627	-0.015344944	-0.000849080	0.010614604	0.016495112
	K= 14	0.016330257	0.011457644	0.004284527	-0.002615341	-0.007280163	-0.008810852	-0.007430784
	K= 21	-0.004181061	-0.000444248	0.002554669	0.004088048	0.004044000	0.002822823	0.001093382
	K= 28	-0.000483264	-0.001464449	-0.001715713	-0.002413100			
346.	K= 0	0.179624856	0.170052886	0.143208981	0.104263186	0.060467575	0.019480094	-0.012323122
	K= 7	-0.031134367	-0.036308050	-0.030143090	-0.016982835	-0.001911625	0.010568053	0.017542847
	K= 14	0.018145412	0.013418924	0.005704939	-0.002242341	-0.008096293	-0.010544375	-0.009488497
	K= 21	-0.005873427	-0.001221457	0.002921315	0.005425274	0.005871899	0.004521873	0.002130557
	K= 28	-0.000384539	-0.002250348	-0.003049867	-0.006581858			
347.	K= 0	0.245145261	0.221147954	0.157728732	0.076887250	0.004688833	-0.039293110	-0.048900090
	K= 7	-0.031854864	-0.004218936	0.017914306	0.025312975	0.018114898	0.003522299	-0.009341035
	K= 14	-0.014384780	-0.010905210	-0.002707430	0.004883354	0.008122500	0.006418593	0.001889796
	K= 21	-0.002407271	-0.004321862	-0.003516054	-0.001169193	0.001060527	0.002058186	0.001696687
	K= 28	0.000610765	-0.000385204	-0.000804297	-0.000920669			
348.	K= 0	0.252173841	0.226064920	0.157612443	0.071900666	-0.002076359	-0.043777931	-0.048574109
	K= 7	-0.027175620	0.001804181	0.021685686	0.024840038	0.014064733	-0.001413948	-0.012243290
	K= 14	-0.013849922	-0.007693633	0.000981887	0.006899189	0.007611033	0.004114445	-0.000582532
	K= 21	-0.003639958	-0.003899813	-0.002053800	0.000271470	0.001692272	0.001759856	0.000909338
	K= 28	-0.000079415	-0.000640322	-0.000662562	-0.000435570			

NO.	INDEX	HO(K)	HO(K+1)	HO(K+2)	HO(K+3)	HO(K+4)	HO(K+5)	HO(K+6)
349.	K= 0	0.258699000	0.230527163	0.157227099	0.067009866	-0.008287050	-0.047406618	-0.047518030
	K= 7	-0.022373535	0.007150050	0.024283588	0.023376711	0.009842958	-0.005550738	-0.013842322
	K= 14	-0.012311812	-0.004391726	0.003827419	0.007706344	0.006289158	0.001850145	-0.002287891
	K= 21	-0.003938608	-0.002962980	-0.000730837	0.001129905	0.001743252	0.001229953	0.000287456
	K= 28	-0.000420426	-0.000630004	-0.000465749	-0.000212044			
350.	K= 0	0.244178593	0.220567703	0.158019781	0.077880681	0.005666263	-0.039093561	-0.049725141
	K= 7	-0.033224691	-0.005222391	0.018007819	0.026538912	0.019753642	0.004544400	-0.009611592
	K= 14	-0.015822615	-0.012654323	-0.003713440	0.005216293	0.009570446	0.008101515	0.002823801
	K= 21	-0.002712556	-0.005604535	-0.004971102	-0.001967162	0.001288369	0.003057173	0.002812451
	K= 28	0.001219501	-0.000524063	-0.001474219	-0.002417452			
351.	K= 0	0.251926482	0.226009429	0.157945395	0.072414935	-0.001854706	-0.044195972	-0.049512543
	K= 7	-0.028052162	0.001651784	0.022504050	0.026217822	0.015152454	-0.001351563	-0.013316512
	K= 14	-0.015437327	-0.008825593	0.001000925	0.008045536	0.009168927	0.005144950	-0.000650689
	K= 21	-0.004683975	-0.005230833	-0.002883296	0.000350074	0.002509469	0.002747415	0.001490382
	K= 28	-0.000159399	-0.001232911	-0.001389001	-0.001121121			
352.	K= 0	0.259052873	0.230892897	0.157543421	0.067066908	-0.008700375	-0.048250969	-0.048392929
	K= 7	-0.022704601	0.007710207	0.025535591	0.024612386	0.010269742	-0.006269947	-0.015321005
	K= 14	-0.013655860	-0.004771810	0.004634716	0.009179723	0.007514935	0.002116265	-0.003060146
	K= 21	-0.005197342	-0.003925707	-0.000886047	0.001750832	0.002664915	0.001885327	0.000361144
	K= 28	-0.000868371	-0.001289505	-0.001016341	-0.000535339			
353.	K= 0	0.265672326	0.235321760	0.156885028	0.061848808	-0.014944527	-0.051427335	-0.046591736
	K= 7	-0.017363995	0.012939360	0.027330264	0.022125095	0.005472466	-0.010127146	-0.015938077
	K= 14	-0.011052415	-0.000988801	0.007104229	0.009035386	0.005283959	-0.000481880	-0.004401274
	K= 21	-0.004744444	-0.002339870	0.000641326	0.002351258	0.002241848	0.000966751	-0.000398233
	K= 28	-0.001120713	-0.001101477	-0.000679676	-0.000263017			
354.	K= 0	0.243401825	0.220118225	0.158307016	0.078746557	0.006474577	-0.039005477	-0.050552573
	K= 7	-0.034506880	-0.006111484	0.018187411	0.027804337	0.021395467	0.005540106	-0.009948321
	K= 14	-0.017376494	-0.014543824	-0.004809361	0.005598795	0.011241883	0.010092717	0.003978025
	K= 21	-0.003054615	-0.007222615	-0.006903429	-0.003111752	0.001539883	0.004482243	0.004539367
	K= 28	0.002269628	-0.000668013	-0.002614515	-0.006587334			
355.	K= 0	0.252051890	0.226214409	0.158271134	0.072662950	-0.001996213	-0.044861414	-0.050447658
	K= 7	-0.028690271	0.001832893	0.023570471	0.027640384	0.016073205	-0.001580661	-0.014668714
	K= 14	-0.017167788	-0.009895679	0.001271665	0.009534340	0.011003327	0.006235126	-0.000939894
	K= 21	-0.006149009	-0.006973602	-0.003878008	0.000635960	0.003823963	0.004250769	0.002283651
	K= 28	-0.000522055	-0.002549960	-0.003013565	-0.002995389			
356.	K= 0	0.259920597	0.231610596	0.157828809	0.066732407	-0.009618632	-0.049402241	-0.049194206

NO.	INDEX	HO(K)	HO(K+1)	HO(K+2)	HO(K+3)	HO(K+4)	HO(K+5)	HO(K+6)
	K= 7	-0.022633914	0.008756325	0.027075648	0.025780644	0.010320641	-0.007461362	-0.017113272
	K= 14	-0.014990550	-0.004824709	0.005918965	0.011032760	0.008819737	0.002106595	-0.004330687
	K= 21	-0.006915413	-0.005051944	-0.000800876	0.002901872	0.004117109	0.002756959	0.000166003
	K= 28	-0.002008796	-0.002816331	-0.002317334	-0.001404848			
357.	K= 0	0.267161965	0.236447334	0.157078803	0.060970914	-0.016498845	-0.052867290	-0.047105585
	K= 7	-0.016594626	0.014643639	0.029027436	0.022803377	0.004677374	-0.011965498	-0.017726611
	K= 14	-0.011702169	-0.000106463	0.008959878	0.010711733	0.005773492	-0.001413841	-0.006105788
	K= 21	-0.006145284	-0.002628760	0.001532962	0.003781090	0.003312864	0.001073800	-0.001279225
	K= 28	-0.002530697	-0.002448056	-0.001574559	-0.000678103			
358.	K= 0	0.273905993	0.240839422	0.156087577	0.055370629	-0.022737440	-0.055444781	-0.044415567
	K= 7	-0.010718592	0.019544084	0.029716235	0.019129708	-0.000550990	-0.015140038	-0.016958214
	K= 14	-0.007922493	0.003866178	0.010527018	0.009192828	0.002590393	-0.003981698	-0.006544780
	K= 21	-0.004558194	-0.000375546	0.002944781	0.003676211	0.002080921	-0.000330643	-0.002066256
	K= 28	-0.002500617	-0.001920646	-0.001015800	-0.000336469			
359.	K= 0	0.308594882	0.261913121	0.147220492	0.024045501	-0.051633190	-0.059773654	-0.022067681
	K= 7	0.019719236	0.034458626	0.019086353	-0.006821476	-0.020975657	-0.015504804	0.000618241
	K= 14	0.012402140	0.011767160	0.002176798	-0.006766878	-0.008276682	-0.003023277	0.003206092
	K= 21	0.005330354	0.002797799	-0.001157697	-0.003083006	-0.002093844	0.000159840	0.001550165
	K= 28	0.001304088	0.000183139	-0.000636507	-0.000922170			
360.	K= 0	0.307947397	0.261681974	0.147755861	0.024778794	-0.051594608	-0.060637210	-0.023029637
	K= 7	0.019706458	0.035575345	0.020349942	-0.006662901	-0.022196438	-0.017048229	0.000190445
	K= 14	0.013544403	0.013481628	0.002915727	-0.007668007	-0.009997103	-0.004025858	0.003766297
	K= 21	0.006883960	0.003944483	-0.001360084	-0.004334308	-0.003230129	0.000069301	0.002434080
	K= 28	0.002287108	0.000449378	-0.001165514	-0.002419884			
361.	K= 0	0.307427108	0.261520624	0.148240328	0.025391199	-0.051633716	-0.061472677	-0.023896690
	K= 7	0.019772276	0.036706146	0.021572731	-0.006568272	-0.023481429	-0.018632825	-0.000216529
	K= 14	0.014796253	0.015347622	0.003719881	-0.008702707	-0.011991754	-0.005219433	0.004434977
	K= 21	0.008820675	0.005434040	-0.001596638	-0.006032318	-0.004864104	-0.000111945	0.003761681
	K= 28	0.003887204	0.000957056	-0.002065147	-0.006585938			
362.	K= 0	0.372296989	0.292405009	0.113453150	-0.037362017	-0.076832354	-0.025425136	0.032886412
	K= 7	0.038633000	0.002349630	-0.026427794	-0.019541670	0.006534435	0.019183826	0.008104742
	K= 14	-0.009063099	-0.012334738	-0.001508440	0.008309141	0.006759416	-0.001658231	-0.006131437
	K= 21	-0.002877311	0.002549923	0.003750801	0.000650316	-0.002191695	-0.001853488	0.000289005
	K= 28	0.001389866	0.000673766	-0.000440403	-0.000922845			
363.	K= 0	0.380043566	0.295258701	0.107872248	-0.044234287	-0.076398849	-0.018496994	0.037454735
	K= 7	0.035361562	-0.004247583	-0.028071750	-0.014658887	0.011442084	0.018224500	0.003092424

NO.	INDEX	HO(K)	HO(K+1)	HO(K+2)	HO(K+3)	HO(K+4)	HO(K+5)	HO(K+6)
	K= 14	-0.011668932	-0.009776514	0.002453913	0.008818790	0.003802764	-0.004035003	-0.005304065
	K= 21	-0.000450887	0.003464923	0.002473798	-0.000837859	-0.002175673	-0.000779239	0.000919676
	K= 28	0.001033930	0.000050230	-0.000604143	-0.000505043			
364.	K= 0	0.387197673	0.297736347	0.102500379	-0.050342079	-0.075359523	-0.011938788	0.040893354
	K= 7	0.031518921	-0.010000724	-0.028366826	-0.009639490	0.014999788	0.016104251	-0.001390661
	K= 14	-0.012728877	-0.006640449	0.005337439	0.008047186	0.000972064	-0.005177733	-0.003781912
	K= 21	0.001362096	0.003411190	0.001099671	-0.001613301	-0.001662828	0.000046266	0.001050918
	K= 28	0.000582078	-0.000285834	-0.000546922	-0.000284537			
365.	K= 0	0.371897697	0.292401493	0.113965452	-0.037170749	-0.077463210	-0.026106723	0.033234298
	K= 7	0.039762605	0.002788667	-0.027430698	-0.020828772	0.006661490	0.020701308	0.009146389
	K= 14	-0.009865299	-0.014036048	-0.001993580	0.009652354	0.008259628	-0.001836101	-0.007708382
	K= 21	-0.003886257	0.003273412	0.005211737	0.001064497	-0.003192435	-0.002937665	0.000375403
	K= 28	0.002366949	0.001287358	-0.000806027	-0.002420800			
366.	K= 0	0.380414367	0.295550942	0.107831478	-0.044776160	-0.077026904	-0.018405814	0.038402408
	K= 7	0.036134988	-0.004726611	-0.029405467	-0.015221953	0.012477141	0.019668542	0.003123065
	K= 14	-0.013155907	-0.010945570	0.003067570	0.010434777	0.004403621	-0.005138833	-0.006672282
	K= 21	-0.000417424	0.004732434	0.003343279	-0.001338326	-0.003273949	-0.001113509	0.001605733
	K= 28	0.001766815	-0.000047394	-0.001364975	-0.001299700			
367.	K= 0	0.388211846	0.298245907	0.101954937	-0.051454667	-0.075856328	-0.011154700	0.042189475
	K= 7	0.031799354	-0.011202674	-0.029687263	-0.009421200	0.016578261	0.017110378	-0.002240860
	K= 14	-0.014386594	-0.007027138	0.006673429	0.009385183	0.000666853	-0.006636683	-0.004526064
	K= 21	0.002154835	0.004614070	0.001235576	-0.002544513	-0.002403846	0.000316015	0.001830939
	K= 28	0.000872878	-0.000774962	-0.001277983	-0.000719314			
368.	K= 0	0.395417809	0.300575435	0.096315682	-0.057353098	-0.074135959	-0.004383221	0.044828638
	K= 7	0.027065579	-0.016635608	-0.028693691	-0.003826322	0.019136876	0.013667528	-0.006620288
	K= 14	-0.014039855	-0.003021811	0.008798726	0.007280663	-0.002365591	-0.006716583	-0.002119736
	K= 21	0.003640085	0.003604151	-0.000496759	-0.002793313	-0.001270436	0.001153209	0.001517867
	K= 28	0.000101613	-0.001066185	-0.001027594	-0.000409746			
369.	K= 0	0.371571064	0.292422414	0.114422321	-0.037039068	-0.078085065	-0.026728764	0.033618242
	K= 7	0.040874068	0.003185987	-0.028466713	-0.022124987	0.006823201	0.022297010	0.010235962
	K= 14	-0.010742974	-0.015902378	-0.002529647	0.011181690	0.010007232	-0.002036267	-0.009627756
	K= 21	-0.005162753	0.004183862	0.007153422	0.001661304	-0.004592888	-0.004555330	0.000471004
	K= 28	0.003930062	0.002357785	-0.001425725	-0.006590359			
370.	K= 0	0.381037652	0.295932114	0.107601941	-0.045543130	-0.077629089	-0.018069204	0.039510150
	K= 7	0.036788497	-0.005462047	-0.030828543	-0.015601300	0.013763949	0.021147344	0.002918312
	K= 14	-0.014902130	-0.012101401	0.003984507	0.012322985	0.004912812	-0.006638911	-0.008295510

NO.	INDEX	HO(K)	HO(K+1)	HO(K+2)	HO(K+3)	HO(K+4)	HO(K+5)	HO(K+6)
	K= 21	-0.000161580	0.006481376	0.004375063	-0.002236251	-0.004876364	-0.001417524	0.002871224
	K= 28	0.002908696	-0.000569516	-0.003231155	-0.003473792			
371.	K= 0	0.389627159	0.298889160	0.101096153	-0.052913204	-0.076271832	-0.009962585	0.043690279
	K= 7	0.031809960	-0.012811638	-0.031035263	-0.008806605	0.018492613	0.017973717	-0.003551237
	K= 14	-0.016268201	-0.007116716	0.008488882	0.010808561	-0.000071553	-0.008544646	-0.005184878
	K= 21	0.003488694	0.006167185	0.001086941	-0.004069623	-0.003316485	0.001082036	0.003192935
	K= 28	0.001053582	-0.002188239	-0.003130990	-0.001890147			
372.	K= 0	0.397492349	0.301402032	0.094887078	-0.059330937	-0.074255049	-0.002456762	0.046462242
	K= 7	0.026363477	-0.018843718	-0.029654808	-0.002308534	0.021230504	0.013681836	-0.008688834
	K= 14	-0.015534773	-0.002062653	0.010916196	0.007835075	-0.003988434	-0.008346356	-0.001722377
	K= 21	0.005403891	0.004427414	-0.001535252	-0.004221793	-0.001290766	0.002431511	0.002404601
	K= 28	-0.000567877	-0.002792785	-0.002530793	-0.001059182			
373.	K= 0	0.404763222	0.303560972	0.088952303	-0.064951241	-0.071762145	0.004440855	0.048088390
	K= 7	0.020740703	-0.023635250	-0.027159009	0.003572725	0.022310615	0.008940894	-0.012371071
	K= 14	-0.013394073	0.002413284	0.011579804	0.004331648	-0.006537415	-0.006816048	0.001275808
	K= 21	0.005828541	0.002216197	-0.003130143	-0.003363959	0.000465513	0.002790472	0.001234336
	K= 28	-0.001671601	-0.002812915	-0.001908734	-0.000610735			
374.	K= 0	0.436120927	0.311250448	0.061643895	-0.085766256	-0.055291668	0.032411695	0.045804400
	K= 7	-0.006755147	-0.034584165	-0.006907236	0.023162205	0.013173960	-0.012903586	-0.014473155
	K= 14	0.004776079	0.012663893	0.000770555	-0.009312987	-0.003797079	0.005659040	0.004757728
	K= 21	-0.002538711	-0.004321530	0.000368192	0.003183181	0.000798122	-0.001913724	-0.001153950
	K= 28	0.000878293	0.001005606	-0.000225065	-0.000923307			
375.	K= 0	0.435927689	0.311374664	0.061949816	-0.086062610	-0.055887438	0.032682944	0.046746071
	K= 7	-0.006756205	-0.035771273	-0.007376429	0.024365328	0.014187355	-0.013836332	-0.015942425
	K= 14	0.005186606	0.014360469	0.001014183	-0.010930318	-0.004666682	0.006905388	0.006073136
	K= 21	-0.003219729	-0.005808350	0.000435417	0.004555099	0.001247313	-0.002951158	-0.001919238
	K= 28	0.001478140	0.001853497	-0.000411048	-0.002420889			
376.	K= 0	0.435772836	0.311502039	0.062217958	-0.086370587	-0.056452267	0.032974239	0.047669064
	K= 7	-0.006784324	-0.036965992	-0.007828422	0.025607627	0.015223362	-0.014824528	-0.017501451
	K= 14	0.005640797	0.016223524	0.001280421	-0.012773216	-0.005677052	0.008389313	0.007677581
	K= 21	-0.004067391	-0.007724922	0.000515361	0.006435860	0.001897751	-0.004476789	-0.003109907
	K= 28	0.002433799	0.003301909	-0.000728158	-0.006591707			
377.	K= 0	0.499998152	0.317624688	0.000001832	-0.104061306	-0.000001767	0.060307123	0.000001709
	K= 7	-0.040874396	-0.000001612	0.029619537	0.000001504	-0.022153765	-0.000001404	0.016797047
	K= 14	0.000001314	-0.012769725	-0.000001032	0.009659298	0.000000935	-0.007224228	-0.000000815
	K= 21	0.005311128	0.000000573	-0.003814568	-0.000000466	0.002656693	0.000000363	-0.001776107

NO.	INDEX	HO(K)	HO(K+1)	HO(K+2)	HO(K+3)	HO(K+4)	HO(K+5)	HO(K+6)
	K= 28	-0.000000272	0.001122070	0.000000205	-0.000923359			
378.	K= 0	0.507803619	0.317448914	-0.007721845	-0.103544891	0.007480990	0.059478227	-0.007094156
	K= 7	-0.039780065	0.006580897	0.028319255	-0.005967308	-0.020715505	0.005283490	0.015292913
	K= 14	-0.004560791	-0.011269208	0.003831216	0.008225802	-0.003123247	-0.005910680	0.002462441
	K= 21	0.004157409	-0.001868377	-0.002845426	0.001354468	0.001881734	-0.000928672	-0.001190586
	K= 28	0.000595803	0.000707535	-0.000397515	-0.000584368			
379.	K= 0	0.514935374	0.317120790	-0.014749084	-0.102584124	0.014202651	0.057953332	-0.013331804
	K= 7	-0.037796360	0.012192350	0.026009154	-0.010854971	-0.018225286	0.009398006	0.012768414
	K= 14	-0.007900722	-0.008843482	0.006437283	0.006008387	-0.005070258	-0.003981035	0.003847176
	K= 21	0.002560897	-0.002799099	-0.001594621	0.001939958	0.000960498	-0.001268549	-0.000559643
	K= 28	0.000776178	0.000308884	-0.000511648	-0.000380611			
380.	K= 0	0.499998808	0.317789793	0.000001101	-0.104552627	-0.000001047	0.061104696	0.000001014
	K= 7	-0.041946113	-0.000000967	0.030925635	0.000000910	-0.023644488	-0.000000861	0.018419579
	K= 14	0.000000881	-0.014466137	-0.000000662	0.011371993	0.000000653	-0.008899905	-0.000000651
	K= 21	0.006901652	0.000000450	-0.005278602	-0.000000412	0.003961947	0.000000359	-0.002900257
	K= 28	-0.000000308	0.002053434	0.000000273	-0.002421553			
381.	K= 0	0.508605957	0.317595541	-0.008534208	-0.103977740	0.008320939	0.060174800	-0.007974643
	K= 7	-0.040703736	0.007510133	0.029423699	-0.006946214	-0.021947503	0.006305013	0.016596500
	K= 14	-0.005610250	-0.012589224	0.004886620	0.009510867	-0.004160095	-0.007117707	0.003452816
	K= 21	0.005252764	-0.002785149	-0.003804684	0.002175816	0.002692458	-0.001638953	-0.001847690
	K= 28	0.001199045	0.001206164	-0.001044285	-0.001504875			
382.	K= 0	0.516412437	0.317217648	-0.016238756	-0.102866411	0.015727110	0.058396183	-0.014906261
	K= 7	-0.038362354	0.013820823	0.026652601	-0.012528531	-0.018897764	0.011095047	0.013424210
	K= 14	-0.009588949	-0.009444896	0.008077078	0.006528612	-0.006619457	-0.004405569	0.005266722
	K= 21	0.002887985	-0.004057117	-0.001832684	0.003015212	0.001123780	-0.002155028	-0.000659851
	K= 28	0.001497795	0.000332932	-0.001323269	-0.000963847			
383.	K= 0	0.523555636	0.316703916	-0.023242280	-0.101364851	0.022324588	0.056021467	-0.020869128
	K= 7	-0.035290934	0.018977799	0.023102902	-0.016778007	-0.015106484	0.014409218	0.009622980
	K= 14	-0.012007840	-0.005836457	0.009699009	0.003273799	-0.007580861	-0.001610836	0.005724300
	K= 21	0.000604108	-0.004168399	-0.000059340	0.002922377	-0.000182021	-0.001973533	0.000253805
	K= 28	0.001311148	-0.000312564	-0.001291660	-0.000634835			
384.	K= 0	0.499999583	0.317950487	0.000000250	-0.105032682	-0.000000294	0.061891418	0.000000271
	K= 7	-0.043018218	-0.000000260	0.032252468	0.000000265	-0.025193248	-0.000000347	0.020146873
	K= 14	0.000000397	-0.016326036	-0.000000230	0.013325594	0.000000274	-0.010893609	-0.000000304
	K= 21	0.008891523	0.000000168	-0.007220928	-0.000000222	0.005817462	0.000000210	-0.004633393
	K= 28	-0.000000160	0.003635045	0.000000194	-0.006592322			

NO.	INDEX	H0(K)	H0(K+1)	H0(K+2)	H0(K+3)	H0(K+4)	H0(K+5)	H0(K+6)
385.	K= 0	0.505607911	0.317732394	-0.009547208	-0.104381680	0.009366136	0.060828805	-0.009071156
	K= 7	-0.041580085	0.008669835	0.030487191	-0.008175723	-0.023155011	0.007602211	0.017901469
	K= 14	-0.006967425	-0.013944622	0.006289616	0.010871436	-0.005585812	-0.008442294	0.004875470
	K= 21	0.006504707	-0.004177827	-0.004553798	0.003513622	0.003712902	-0.002910990	-0.002715796
	K= 28	0.002444122	0.001868507	-0.002838153	-0.004024375			
386.	K= 0	0.518227100	0.317287445	-0.018067230	-0.103069723	0.017592866	0.058712650	-0.016827587
	K= 7	-0.038762059	0.015805647	0.027098484	-0.014572825	-0.019349560	0.013183028	0.013843782
	K= 14	-0.011693262	-0.009798646	0.010164369	0.006795790	-0.008646499	-0.004570037	0.007195845
	K= 21	0.002950018	-0.005851213	-0.001798746	0.004648134	0.001000042	-0.003624048	-0.000434956
	K= 28	0.002874878	-0.000118048	-0.003545551	-0.002536122			
387.	K= 0	0.526038885	0.316682935	-0.025728948	-0.101294518	0.024822779	0.055889510	-0.023373134
	K= 7	-0.035072856	0.021475539	0.022776045	-0.019243967	-0.014652275	0.016807158	0.009032272
	K= 14	-0.014295213	-0.005113855	0.011830345	0.002436033	-0.009517178	-0.000687974	0.007436387
	K= 21	-0.000366120	-0.005641531	0.000920803	0.004159618	-0.001149707	-0.003004744	0.001235991
	K= 28	0.002245292	-0.001569608	-0.003412676	-0.001645479			
388.	K= 0	0.533192813	0.315961003	-0.032682162	-0.099195123	0.031192642	0.052594647	-0.028846897
	K= 7	-0.030865293	0.025834333	0.017998036	-0.022381037	-0.009658847	0.018738624	0.004159071
	K= 14	-0.015138537	-0.000638539	0.011779387	-0.001446559	-0.008811593	0.002497452	0.006324667
	K= 21	-0.002837634	-0.004349701	0.002735986	0.002867380	-0.002421392	-0.001825979	0.002131901
	K= 28	0.001224525	-0.002442267	-0.002996947	-0.001097200			
389.	K= 0	0.634929538	0.289445460	-0.118198752	-0.030607477	0.075989425	-0.031249706	-0.027423583
	K= 7	0.039782714	-0.008366171	-0.022749070	0.022165310	0.001154334	-0.017359227	0.011464093
	K= 14	0.004885767	-0.012053475	0.004866049	0.005539842	-0.007477757	0.001148036	0.004637524
	K= 21	-0.004010554	-0.000559092	0.003181458	-0.001735433	-0.001006345	0.001797795	-0.000495666
	K= 28	-0.000815156	0.000802234	-0.000042076	-0.000674649			
390.	K= 0	0.641414225	0.286662698	-0.122240484	-0.024449464	0.074704587	-0.036075134	-0.022172470
	K= 7	0.039947268	-0.013376836	-0.018783558	0.023474272	-0.003464937	-0.014793534	0.013451621
	K= 14	0.001086571	-0.010746200	0.007035963	0.002767326	-0.007109903	0.003093378	0.002873027
	K= 21	-0.004195265	0.000918640	0.002236458	-0.002125291	-0.000060203	0.001403919	-0.000854172
	K= 28	-0.000321941	0.000701892	-0.000288390	-0.000506401			
391.	K= 0	0.636163652	0.289087653	-0.119253397	-0.029589314	0.076471508	-0.032663465	-0.026986711
	K= 7	0.041008081	-0.009714652	-0.023076620	0.023837816	0.000246310	-0.018407051	0.013187479
	K= 14	0.004633144	-0.013578899	0.006275825	0.005947787	-0.009136125	0.002015445	0.005526073
	K= 21	-0.005469859	-0.000275142	0.004268091	-0.002779504	-0.001179079	0.002804318	-0.001076078
	K= 28	-0.001216222	0.001572175	-0.000401978	-0.001739893			
392.	K= 0	0.643344820	0.285980046	-0.123696566	-0.022719733	0.074933767	-0.037598807	-0.020991631

NO.	INDEX	HO(K)	HO(K+1)	HO(K+2)	HO(K+3)	HO(K+4)	HO(K+5)	HO(K+6)
	K= 7	0.041024070	-0.015378419	-0.018358063	0.025156226	-0.005173024	-0.015142538	0.C1538958C
	K= 14	-0.000068078	-0.011711836	0.008871503	0.0022608C7	-0.0C8416954	0.004551064	0.C02943200
	K= 21	-0.005539432	0.001861750	0.002692004	-0.003257344	0.000384818	0.00200879E	-C.C01648677
	K= 28	-0.000228328	0.001283830	-0.CC0978976	-0.00128591C			
393.	K= 0	0.649802566	0.283061683	-0.127469838	-0.016475443	0.073039532	-0.042337194	-0.015354622
	K= 7	0.040177975	-0.019919615	-0.013628356	0.025240727	-0.009545308	-0.011486087	C.C1617839Ç
	K= 14	-0.003951035	-0.009148464	0.010079280	-0.000911045	-0.006835230	0.0C5890641	0.000579730
	K= 21	-0.004735831	0.003096044	0.001112863	-0.002987295	0.001358605	0.0C1090232	-C.C0167741C
	K= 28	0.000440192	0.000838873	-0.001228587	-0.000975179			
394.	K= 0	0.637521148	0.288671434	-0.120380938	-0.028437413	0.C76909423	-0.034190997	-0.C26398674
	K= 7	0.042238373	-0.011242799	-0.023266897	0.025612812	-0.000900656	-0.019395981	0.015146725
	K= 14	0.004137214	-0.015198C78	0.008038577	0.006196864	-0.011079423	0.003286160	0.006427679
	K= 21	-0.007394124	0.000356961	0.005593549	-0.004393235	-0.C01157973	0.004265137	-0.00224498I
	K= 28	-0.001601796	0.003025381	-0.001724655	-0.004657429			
395.	K= 0	0.645537496	0.285170C78	-0.125298738	-0.02071064C	0.075049758	-0.040122908	-0.019496709
	K= 7	0.042037547	-0.017674502	-0.017603371	0.026883658	-0.007284567	-0.015207C26	0.C17538022
	K= 14	-0.001705314	-0.012520406	0.011104658	0.001269425	-0.009768583	0.006560098	0.002628111
	K= 21	-0.007161323	0.003427035	0.002951057	-0.004875232	0.0C1421594	0.002645136	-0.C03099762
	K= 28	0.000401872	0.002197929	-0.003132502	-0.003392313			
396.	X= 0	0.652687490	0.281894565	-0.129408896	-0.013743062	0.072758317	-0.044828184	-0.C13052821
	K= 7	0.040773500	-0.022676960	-0.011965975	0.0265847C7	-0.012263484	-0.010568451	0.018048842
	K= 14	-0.006354373	-0.008963C97	C.012201000	-0.002806509	-0.007271502	0.007989720	-0.CC07C8858
	K= 21	-0.005605035	0.004945509	0.000417009	-0.004075006	0.002836049	0.000875016	-0.002842947
	K= 28	0.001649503	0.001017226	-0.C03661627	-0.002537223			
397.	K= 0	0.659099460	0.278837383	-C.132865608	-0.007462487	0.070215404	-0.048528966	-0.00714764C
	K= 7	0.038814612	-0.026447672	-0.006651483	0.025222778	-0.015924286	-0.006001201	0.017248694
	K= 14	-0.009742942	-0.005237322	0.011887044	-0.005783442	-0.004406411	0.008C53873	-C.C03184789
	K= 21	-0.003556141	0.005266603	-0.001520292	-C.002739657	0.00329806C	-0.000558667	-0.002074566
	K= 28	0.002231358	-0.000093661	-0.003753195	-0.001944536			
398.	K= 0	0.822402358	0.168139696	-0.141661525	0.103377342	-0.060538150	0.020695597	C.C10012228
	K= 7	-0.028105482	0.033242330	-0.027874786	0.016249474	-0.003090261	-0.007638626	0.013575405
	K= 14	-0.014229026	0.010698073	-0.005005371	-0.000685745	0.004732426	-0.006373186	0.C05747493
	K= 21	-0.003636516	0.001067903	0.001063897	-0.00224227C	0.002392137	-0.001784291	0.C00850724
	K= 28	0.000004087	-0.000530337	C.000671200	-0.000825116			
399.	K= 0	0.826217413	0.164872527	-0.139870882	0.103543699	-0.0625562C7	0.023923062	0.C06541327
	K= 7	-0.025376320	0.031964403	-0.028288968	0.018090244	-0.C05708821	-0.005046912	0.011717822

NO.	INDEX	HO(K)	HO(K+1)	HO(K+2)	HO(K+3)	HO(K+4)	HO(K+5)	HO(K+6)
	K= 14	-0.013517428	0.011163920	-0.006342463	0.001015981	0.003191425	-0.005379047	0.005458411
	K= 21	-0.003977735	0.001801741	0.000232634	-0.001563940	0.002007810	-0.001709825	0.001006472
	K= 28	-0.000259365	-0.000271806	0.000485734	-0.000755639			
400.	K= 0	0.824688494	0.166281521	-0.140927732	0.104042947	-0.062355176	0.022989832	0.008086979
	K= 7	-0.027252182	0.033763938	-0.029569358	0.018494837	-0.005082399	-0.006589483	0.013802327
	K= 14	-0.015605111	0.012701776	-0.006927263	0.000517148	0.004594475	-0.007259563	0.007274684
	K= 21	-0.005242933	0.002227525	0.000669380	-0.002634078	0.003329849	-0.002882855	0.001737448
	K= 28	-0.000439170	-0.000562449	0.001033535	-0.002143236			
401.	K= 0	0.829200685	0.162400424	-0.138753116	0.104150772	-0.064661443	0.026789445	0.003896071
	K= 7	-0.023835260	0.032009434	-0.029849175	0.020587735	-0.008277897	-0.003250683	0.011232566
	K= 14	-0.014411952	0.013048112	-0.008530889	0.002782468	0.002365524	-0.005653203	0.006615665
	K= 21	-0.005541794	0.003224344	-0.000623414	-0.001450711	0.002546173	-0.002610020	0.001918423
	K= 28	-0.000903360	-0.000015381	0.000561463	-0.001941204			
402.	K= 0	0.832928002	0.159169793	-0.136872709	0.104094744	-0.066397846	0.029801108	0.000452045
	K= 7	-0.020879328	0.030281499	-0.029712960	0.021955676	-0.010667048	-0.000553510	0.008553508
	K= 14	-0.013089068	0.012902208	-0.009442993	0.004367922	0.000617086	-0.004217081	0.005805966
	K= 21	-0.005448323	0.003728645	-0.001468250	-0.000564544	0.001858697	-0.002251937	0.001895816
	K= 28	-0.001125725	0.000321711	0.000227738	-0.001787405			
403.	K= 0	0.826934099	0.164448619	-0.140181422	0.104662359	-0.064123452	0.025272410	0.006111808
	K= 7	-0.026297964	0.034180880	-0.031221319	0.020809960	-0.007256784	-0.005305853	0.013843160
	K= 14	-0.016942274	0.014867466	-0.009186786	0.002124373	0.004144084	-0.008063972	0.009015724
	K= 21	-0.007313874	0.003950778	-0.000192291	-0.002838453	0.004443251	-0.004478037	0.003298200
	K= 28	-0.001530004	-0.000137594	0.001196464	-0.005765785			
404.	K= 0	0.832293093	0.159817815	-0.137530208	0.104684532	-0.066766143	0.029763076	0.001033992
	K= 7	-0.022013921	0.031801473	-0.031288292	0.023172442	-0.011150960	-0.001011549	0.010312252
	K= 14	-0.015045784	0.014964577	-0.011065923	0.005114004	0.000945741	-0.005518418	0.007707946
	K= 21	-0.007423025	0.005251989	-0.002170624	-0.000801133	0.002888739	-0.003730535	0.003403137
	K= 28	-0.002317945	0.001029928	-0.000041076	-0.005161956			
405.	K= 0	0.836710513	0.155968070	-0.135230303	0.104500711	-0.068702638	0.033271719	-0.003106615
	K= 7	-0.018311683	0.029449869	-0.030807473	0.024571452	-0.013953749	0.002389790	0.007211115
	K= 14	-0.012992933	0.014372043	-0.011930790	0.007059146	-0.001466861	-0.003298809	0.006209921
	K= 21	-0.006918203	0.005714696	-0.003326733	0.000638624	0.001579583	-0.002860635	0.003111350
	K= 28	-0.002568587	0.001670420	-0.000891318	-0.004705705			
406.	K= 0	0.840355515	0.152768910	-0.133253872	0.104209661	-0.070131063	0.036025230	-0.006474365
	K= 7	-0.015166238	0.027270667	-0.030061547	0.025345102	-0.015952379	0.005038060	0.004602622
	K= 14	-0.011043828	0.013480213	-0.012191352	0.008272193	-0.003219718	-0.001501579	0.004807241

NO.	INDEX	HO(K)	HO(K+1)	HO(K+2)	HO(K+3)	HO(K+4)	HO(K+5)	HO(K+6)
	K= 21	-0.006188191	0.005724944	-0.003945585	0.001602972	0.000572922	-0.002073606	0.002700065
	K= 28	-0.002563441	0.002018277	-0.001490667	-0.004358754			
407.	K= 0	0.128078043	0.124568045	0.114394009	0.098579228	0.078688383	0.056636117	0.034457561
	K= 7	0.014071368	-0.002933600	-0.015460327	-0.022995792	-0.025624078	-0.023963399	-0.019040097
	K= 14	-0.012120716	-0.004527844	0.002534003	0.008119442	0.011633754	0.012866694	0.011969518
	K= 21	0.009384323	0.005740456	0.001737108	-0.001969439	-0.004858494	-0.006604820	-0.007101819
	K= 28	-0.006448243	-0.004905302	-0.002834408	-0.000627610	0.001357263	0.002847774	0.003687171
	K= 35	0.003842486	0.003391947	0.002496444	0.001361844	0.000199867	-0.000806470	-0.001527512
	K= 42	-0.001899107	-0.001922390	-0.001653095	-0.001183318	-0.000620842	-0.000068858	0.000389746
	K= 49	0.000702222	0.000848924	0.000840292	0.000709318	0.000501664	0.000265572	0.000043306
	K= 56	-0.000134602	-0.000251876	-0.000306023	-0.000305492	-0.000265589	-0.000204054	-0.000137313
	K= 63	-0.000102277						
408.	K= 0	0.128454387	0.124947011	0.114774883	0.098946154	0.079005420	0.056850124	0.034507338
	K= 7	0.013902601	-0.003351654	-0.016120259	-0.023843568	-0.026560023	-0.024853308	-0.019735631
	K= 14	-0.012485642	-0.004465248	0.003058964	0.009066377	0.012886863	0.014248569	0.013267756
	K= 21	0.010386221	0.006269816	0.001686746	-0.002615906	-0.006019752	-0.008112211	-0.008724932
	K= 28	-0.007932279	-0.006013427	-0.003387495	-0.000534641	0.002083121	0.004091222	0.005250055
	K= 35	0.005476967	0.004841771	0.003538613	0.001843028	0.000059747	-0.001527925	-0.002699558
	K= 42	-0.003324084	-0.003370170	-0.002899766	-0.002046730	-0.000987337	0.000091185	0.001022097
	K= 49	0.001682721	0.002005715	0.001985352	0.001667071	0.001135758	0.000495691	-0.000147732
	K= 56	-0.000704657	-0.001112088	-0.001339481	-0.001387880	-0.001284543	-0.001073735	-0.000806983
	K= 63	-0.000833342						
409.	K= 0	0.135860145	0.131706119	0.119709492	0.101203442	0.078208387	0.053161390	0.028596334
	K= 7	0.006821483	-0.010359094	-0.021841578	-0.027311899	-0.027220521	-0.022653013	-0.015121739
	K= 14	-0.006314676	0.002158323	0.008983992	0.013298642	0.014758550	0.013524290	0.010169927
	K= 21	0.005538575	0.000572189	-0.003853681	-0.007064939	-0.008675639	-0.008616168	-0.007105947
	K= 28	-0.004581135	-0.001594719	0.001291202	0.003601668	0.005018327	0.005414333	0.004851796
	K= 35	0.003547285	0.001815389	0.000002499	-0.001576532	-0.002687606	-0.003207013	-0.003127304
	K= 42	-0.002542940	-0.001620044	-0.000558238	0.000447962	0.001241190	0.001722127	0.001857379
	K= 49	0.001674714	0.001248647	0.000680374	0.000076516	-0.000469389	-0.000889814	-0.001149421
	K= 56	-0.001244465	-0.001196919	-0.001045378	-0.000835003	-0.000608555	-0.000399858	-0.000230482
	K= 63	-0.000128759						
410.	K= 0	0.183710575	0.173589289	0.145243526	0.104244351	0.058392476	0.015902229	-0.016438767
	K= 7	-0.034671482	-0.038298346	-0.030032679	-0.014788300	0.001774194	0.014732271	0.021028176
	K= 14	0.019976322	0.013080895	0.003288463	-0.006055832	-0.012224555	-0.013813976	-0.010976281
	K= 21	-0.005167849	0.001455024	0.006771490	0.009329520	0.008701138	0.005483706	0.000990489

NO.	INDEX	H0(K)	H0(K+1)	H0(K+2)	H0(K+3)	H0(K+4)	H0(K+5)	H0(K+6)
	K= 28	-0.003239334	-0.005940214	-0.006474894	-0.004952591	-0.002102681	0.001028025	0.003438999
	K= 35	0.004479997	0.004008412	0.002368744	0.000221921	-0.001701493	-0.002838458	-0.002946376
	K= 42	-0.002135934	-0.000787733	0.000604416	0.001604385	0.001962253	0.001664854	0.000905645
	K= 49	-0.000007782	-0.000768532	-0.001167155	-0.001141337	-0.000772370	-0.000235613	0.000273265
	K= 56	0.000601260	0.000682077	0.000539226	0.000262836	-0.000033070	-0.000251891	-0.000342744
	K= 63	-0.000676859						
411.	K= 0	0.183067620	0.173093677	0.145128191	0.104580581	0.059056118	0.016619373	-0.015983026
	K= 7	-0.034703165	-0.038855817	-0.030939292	-0.015709318	0.001208029	0.014780510	0.021731466
	K= 14	0.021125495	0.014281053	0.004096895	-0.005966526	-0.012938235	-0.015126456	-0.012454953
	K= 21	-0.006297190	0.001091539	0.007338397	0.010671195	0.010384705	0.006941993	0.001716153
	K= 28	-0.003515264	-0.007149085	-0.008228019	-0.006669186	-0.003205808	0.000914687	0.004361760
	K= 35	0.006137632	0.005852528	0.003789112	0.000751146	-0.002231803	-0.004243862	-0.004755206
	K= 42	-0.003749858	-0.001683499	0.000702474	0.002640403	0.003574926	0.003315521	0.002059800
	K= 49	0.000293955	-0.001383987	-0.002462451	-0.002670949	-0.002035247	-0.000841358	0.000482555
	K= 56	0.001515722	0.001966084	0.001759991	0.001041884	0.000082698	-0.000784030	-0.001307077
	K= 63	-0.005731151						
412.	K= 0	0.246808410	0.222693920	0.158788681	0.076884151	0.003164052	-0.042145185	-0.051961318
	K= 7	-0.033455051	-0.003082424	0.021705426	0.030041862	0.021189947	0.002950423	-0.013638683
	K= 14	-0.020289291	-0.015159287	-0.002773293	0.009260114	0.014633369	0.011439037	0.002558739
	K= 21	-0.006503340	-0.010880847	-0.008843839	-0.002315103	0.004624128	0.008192375	0.006897818
	K= 28	0.002052279	-0.003285883	-0.006177988	-0.005375031	-0.001779714	0.002312374	0.004630614
	K= 35	0.004155021	0.001507143	-0.001599089	-0.003428636	-0.003167920	-0.001243134	0.001079099
	K= 42	0.002493443	0.002368970	0.000995766	-0.000704830	-0.001770703	-0.001727171	-0.000770703
	K= 49	0.000441284	0.001219074	0.001218697	0.000572628	-0.000261578	-0.000806287	-0.000823777
	K= 56	-0.000404608	0.000144141	0.000504999	0.000525417	0.000267149	-0.000071347	-0.000292622
	K= 63	-0.000677149						
413.	K= 0	0.255978448	0.229047060	0.158630610	0.070342541	-0.005808230	-0.048175614	-0.051497664
	K= 7	-0.026872315	0.005601771	0.027298737	0.029302783	0.014717147	-0.005271807	-0.018706400
	K= 14	-0.019321844	-0.008942243	0.004838549	0.013742961	0.013497081	0.005609151	-0.004327442
	K= 21	-0.010372482	-0.009642515	-0.003511090	0.003767143	0.007879335	0.006919987	0.002144478
	K= 28	-0.003187024	-0.005952612	-0.004935373	-0.001252327	0.002614974	0.004436165	0.003472452
	K= 35	0.000682710	-0.002075175	-0.003240511	-0.002397010	-0.000335111	0.001586844	0.002306799
	K= 42	0.001616122	0.000138541	-0.001163035	-0.001590471	-0.001059927	-0.000040446	0.000811032
	K= 49	0.001054640	0.000673795	0.000002323	-0.000532188	-0.000666311	-0.000413010	0.000005110
	K= 56	0.000325304	0.000398110	0.000241748	-0.000009606	-0.000208363	-0.000275878	-0.000223736
	K= 63	-0.000137219						

NO.	INDEX	HO(K)	HO(K+1)	HO(K+2)	HO(K+3)	HO(K+4)	HO(K+5)	HO(K+6)
414.	K= 0	0.246382296	0.222445786	0.158940315	0.077350259	0.003600983	-0.042097785	-0.052410420
	K= 7	-0.034147907	-0.003550661	0.021834489	0.030771032	0.022108059	0.003467094	-0.013914965
	K= 14	-0.021271359	-0.016292561	-0.003352761	0.009650536	0.015832849	0.012768738	0.003210622
	K= 21	-0.006972969	-0.012255285	-0.010342918	-0.003043347	0.005138237	0.009693146	0.008529689
	K= 28	0.002853366	-0.003812026	-0.007754721	-0.007099591	-0.002645730	0.002822545	0.006234866
	K= 35	0.005930163	0.002425453	-0.002069285	-0.005012844	-0.004947834	-0.002193854	0.001493444
	K= 42	0.004015502	0.004110124	0.001958983	-0.001049232	-0.003193187	-0.003389757	-0.001722972
	K= 49	0.000713406	0.002514010	0.002765043	0.001489365	-0.000459537	-0.001951892	-0.002227059
	K= 56	-0.001263676	0.000275720	0.001488979	0.001762696	0.001048552	-0.000143071	-0.001114083
	K= 63	-0.005731199						
415.	K= 0	0.256967962	0.229862392	0.158755422	0.069697976	-0.006913077	-0.049180139	-0.051863711
	K= 7	-0.026368972	0.006750170	0.028497785	0.029887125	0.014319785	-0.006484859	-0.020088647
	K= 14	-0.020085629	-0.008610174	0.006130431	0.015285452	0.014395300	0.005306296	-0.005698696
	K= 21	-0.012037609	-0.010623224	-0.003206281	0.005206600	0.009619549	0.007930141	0.001814241
	K= 28	-0.004672837	-0.007715527	-0.005926494	-0.000883448	0.004117060	0.006168999	0.004404344
	K= 35	0.000273405	-0.003557024	-0.004893415	-0.003239107	0.000107243	0.003010130	0.003837163
	K= 42	0.002348396	-0.000323386	-0.002493310	-0.002966561	-0.001673829	0.000424739	0.002020739
	K= 49	0.002257274	0.001167607	-0.000455445	-0.001611836	-0.001694635	-0.000787471	0.000470472
	K= 56	0.001315322	0.001299068	0.000490719	-0.000636738	-0.001519934	-0.001811282	-0.001512430
	K= 63	-0.001119248						
416.	K= 0	0.266217291	0.236133099	0.158018827	0.062455334	-0.015972514	-0.054230984	-0.049709186
	K= 7	-0.018473752	0.015258148	0.032174312	0.026472233	0.006129954	-0.014132366	-0.022344436
	K= 14	-0.015656311	-0.000491575	0.012684148	0.016176671	0.009252470	-0.002407257	-0.011022586
	K= 21	-0.011715662	-0.005095761	0.003825781	0.009264391	0.008307129	0.002340416	-0.004337337
	K= 28	-0.007521294	-0.005677808	-0.000560161	0.004276797	0.005889192	0.003682983	-0.000512294
	K= 35	-0.003872238	-0.004440293	-0.002220953	0.001073008	0.003290847	0.003219053	0.001200922
	K= 42	-0.001279474	-0.002655365	-0.002242411	-0.000533630	0.001262632	0.002053344	0.001503521
	K= 49	0.000129089	-0.001134252	-0.001548687	-0.000981622	0.000105173	0.001010018	0.001225573
	K= 56	0.000688686	-0.000261727	-0.001137831	-0.001582521	-0.001516393	-0.001104184	-0.000605735
	K= 63	-0.000233889						
417.	K= 0	0.310044467	0.263154328	0.147650778	0.022992965	-0.054049488	-0.062048264	-0.022123985
	K= 7	0.022594191	0.038393538	0.020735152	-0.009369943	-0.026075780	-0.018910363	0.002147243
	K= 14	0.017972920	0.016756475	0.002136851	-0.012062881	-0.014394846	-0.004642721	0.007576857
	K= 21	0.011950698	0.005944129	-0.004160944	-0.009543724	-0.006390795	0.001618046	0.007280290
	K= 28	0.006234404	0.000189571	-0.005245063	-0.005672179	-0.001377886	0.003498018	0.004867084
	K= 35	0.002057764	-0.002071952	-0.003951445	-0.002336524	0.000973712	0.003029471	0.002318418

NO.	INDEX	HO(K)	HO(K+1)	HO(K+2)	HO(K+3)	HO(K+4)	HO(K+5)	HO(K+6)
	K= 42	-0.000186855	-0.002178007	-0.002100022	-0.000322505	0.001446927	0.001765956	0.000601494
	K= 49	-0.000862318	-0.001386675	-0.000702412	0.000429370	0.001015156	0.000678926	-0.000138002
	K= 56	-0.000687333	-0.000579613	-0.000033284	0.000423636	0.000445511	0.000111746	-0.000230398
	K= 63	-0.000677246						
418.	K= 0	0.309757113	0.263059378	0.147905827	0.023324858	-0.054060653	-0.062487084	-0.022583738
	K= 7	0.022633355	0.039004821	0.021397763	-0.009346288	-0.026814535	-0.019793306	0.001969620
	K= 14	0.018766284	0.017873626	0.002547655	-0.012818348	-0.015714347	-0.005341500	0.008196197
	K= 21	0.013409540	0.006954871	-0.004550599	-0.011053294	-0.007702529	0.001700736	0.008736670
	K= 28	0.007800795	0.000463327	-0.006543096	-0.007418033	-0.002024625	0.004541904	0.006695248
	K= 35	0.003058052	-0.002787730	-0.005755384	-0.003639115	0.001314578	0.004701342	0.003843432
	K= 42	-0.000138778	-0.003623183	-0.003750032	-0.000737672	0.002596346	0.003438686	0.001332883
	K= 49	-0.001669993	-0.002978347	-0.001675261	0.000884381	0.002440678	0.001806549	-0.000259729
	K= 56	-0.001882923	-0.001764451	-0.000202771	0.001350567	0.001603171	0.000504758	-0.000877080
	K= 63	-0.005731452						
419.	K= 0	0.373336315	0.293284714	0.113470316	-0.038877152	-0.078891754	-0.025551822	0.035635084
	K= 7	0.041531254	0.001607800	-0.030661084	-0.022433568	0.008928228	0.024526902	0.009950057
	K= 14	-0.013388135	-0.017902501	-0.001449639	0.014221024	0.011455309	-0.003992595	-0.012768459
	K= 21	-0.005757496	0.006923933	0.010013826	0.001214481	-0.007853240	-0.006746899	0.001970734
	K= 28	0.007320117	0.003580503	-0.003798994	-0.005875260	-0.000938171	0.004441593	0.004027676
	K= 35	-0.000952142	-0.004184421	-0.002192692	0.002041107	0.003363271	0.000659571	-0.002418534
	K= 42	-0.002300709	0.000421107	0.002263948	0.001258694	-0.001021768	-0.001790612	-0.000411912
	K= 49	0.001209056	0.001198779	-0.000158423	-0.001102852	-0.000643564	0.000451304	0.000837887
	K= 56	0.000218069	-0.000520352	-0.000532173	0.000044732	0.000445722	0.000268122	-0.000158923
	K= 63	-0.000677305						
420.	K= 0	0.383219838	0.296933532	0.106302977	-0.047785684	-0.078332186	-0.016323790	0.041852854
	K= 7	0.037001453	-0.007812977	-0.033109758	-0.015018068	0.016720004	0.022994351	0.001284547
	K= 14	-0.018200140	-0.013040159	0.006698154	0.015454479	0.004557587	-0.010145772	-0.010645993
	K= 21	0.001602367	0.010207936	0.005435385	-0.005152863	-0.008122507	-0.000993119	0.006328873
	K= 28	0.005087327	-0.002040413	-0.005735878	-0.002084529	0.003522305	0.004138276	-0.000243259
	K= 35	-0.003690239	-0.002257123	0.001624956	0.002994282	0.000624855	-0.002103125	-0.001924528
	K= 42	0.000477211	0.001920138	0.000880289	-0.001001515	-0.001388535	-0.000100928	0.001064068
	K= 49	0.000786368	-0.000336873	-0.000852426	-0.000295155	0.000478807	0.000547318	-0.000012543
	K= 56	-0.000431611	-0.000273365	0.000152373	0.000309631	0.000077971	-0.000226783	-0.000304995
	K= 63	-0.000183797						
421.	K= 0	0.373160899	0.293290973	0.113707721	-0.038803622	-0.079208612	-0.025872495	0.035836220
	K= 7	0.042111069	0.001804967	-0.031227197	-0.023125570	0.009049196	0.025435403	0.010538794

NO.	INDEX	HO(K)	HO(K+1)	HO(K+2)	HO(K+3)	HO(K+4)	HO(K+5)	HO(K+6)
	K= 14	-0.013952486	-0.019017857	-0.001711184	0.015245676	0.012557566	-0.004231628	-0.014148701
	K= 21	-0.006593563	0.007735617	0.011540715	0.001560509	-0.009184022	-0.008153129	0.002252792
	K= 28	0.008997362	0.004600681	-0.004725631	-0.007641077	-0.001367180	0.005901735	0.005594406
	K= 35	-0.001211871	-0.005960543	-0.003303661	0.002957904	0.005175147	0.001143165	-0.003839459
	K= 42	-0.003868168	0.000616597	0.003950320	0.002355258	-0.001829308	-0.003469521	-0.000906478
	K= 49	0.002454721	0.002619782	-0.000276344	-0.002549997	-0.001624557	0.001089649	0.002246598
	K= 56	0.000673542	-0.001501215	-0.001696992	0.000093025	0.001563851	0.001057740	-0.000605266
	K= 63	-0.005731784						
422.	K= 0	0.384607255	0.297507048	0.105382919	-0.049128897	-0.078511536	-0.015101165	0.043048300
	K= 7	0.036730185	-0.009269338	-0.034022108	-0.014253642	0.018285450	0.023464441	0.000038927
	K= 14	-0.019681264	-0.012926724	0.008318204	0.016609021	0.003790813	-0.011927761	-0.011237778
	K= 21	0.002968988	0.011858363	0.005304437	-0.006925013	-0.009329375	-0.000114624	0.008202411
	K= 28	0.005608633	-0.003523202	-0.007356990	-0.001812760	0.005327448	0.005199626	-0.001239254
	K= 35	-0.005460329	-0.002577164	0.003115956	0.004389025	0.000193492	-0.003761053	-0.002707317
	K= 42	0.001502058	0.003405227	0.000970423	-0.002346786	-0.002435960	0.000420698	0.002421025
	K= 49	0.001261568	-0.001269851	-0.001956340	-0.000203402	0.001573895	0.001230062	-0.000564836
	K= 56	-0.001466799	-0.000460928	0.001063249	0.001174425	-0.000347008	-0.001971954	-0.002277995
	K= 63	-0.001500843						
423.	K= 0	0.394593000	0.300869942	0.097679794	-0.057656761	-0.076581597	-0.005345747	0.047677197
	K= 7	0.030190591	-0.018210433	-0.033563614	-0.005165156	0.023902509	0.018320203	-0.008872610
	K= 14	-0.020602964	-0.004875287	0.014565617	0.012964323	-0.004664324	-0.014022410	-0.004491482
	K= 21	0.009449478	0.009686708	-0.002326067	-0.009899106	-0.004034314	0.006204668	0.007356312
	K= 28	-0.000921802	-0.007031213	-0.003526277	0.004000861	0.005568285	-0.000070353	-0.004929442
	K= 35	-0.002990513	0.002465584	0.004146844	0.000418690	-0.003360838	-0.002455195	0.001398287
	K= 42	0.003005703	0.000660020	-0.002193651	-0.001941447	0.000682727	0.002103950	0.000729177
	K= 49	-0.001357969	-0.001482962	0.000241529	0.001441133	0.000701857	-0.000829836	-0.001171867
	K= 56	-0.000000760	0.001151850	0.000870993	-0.000602477	-0.001882321	-0.002018076	-0.001250525
	K= 63	-0.000421848						
424.	K= 0	0.436658680	0.311864018	0.061552417	-0.087336183	-0.056383625	0.034212045	0.048400525
	K= 7	-0.007839303	-0.038456731	-0.007399023	0.027576488	0.015727710	-0.016817167	-0.019027054
	K= 14	0.007133987	0.018593393	0.000733573	-0.015580431	-0.006336659	0.011079062	0.009544656
	K= 21	-0.006079879	-0.010525990	0.001405219	0.009686839	0.002351806	-0.007585190	-0.004856139
	K= 28	0.004830409	0.006026119	-0.001991603	-0.005994942	-0.000475897	0.005048718	0.002276042
	K= 35	-0.003551010	-0.003283846	0.001869845	0.003529122	-0.000318920	-0.003158635	-0.000882972
	K= 42	0.002386430	0.001627513	-0.001441724	-0.001909402	0.000527855	0.001804706	0.000209562
	K= 49	-0.001436743	-0.000693428	0.000944247	0.000912121	-0.000449852	-0.000906369	0.000043080

NO.	INDEX	HO(K)	HO(K+1)	HO(K+2)	HO(K+3)	HO(K+4)	HO(K+5)	HO(K+6)
	K= 56	0.000746767	0.000229253	-0.000512881	-0.000360138	0.000274589	0.000372933	-0.000081016
	K= 63	-0.000677307						
425.	K= 0	0.436517260	0.311926901	0.061689768	-0.087490201	-0.056669474	0.034362528	0.048874602
	K= 7	-0.007859342	-0.039086387	-0.007630091	0.028256446	0.016284555	-0.017390806	-0.019908875
	K= 14	0.007429380	0.019711450	0.000859493	-0.016767655	-0.006957460	0.012120791	0.010637943
	K= 21	-0.006756976	-0.011966262	0.001544127	0.011263311	0.002838417	-0.009038400	-0.005944081
	K= 28	0.005901735	0.007576033	-0.002475422	-0.007774368	-0.000689310	0.006772302	0.003174132
	K= 35	-0.004934557	-0.004731987	0.002686077	0.005296391	-0.000437036	-0.004958898	-0.001472476
	K= 42	0.003931731	0.002811582	-0.002495358	-0.003476856	0.000944011	0.003487920	0.000458592
	K= 49	-0.002965497	-0.001524609	0.002089622	0.002151276	-0.001064979	-0.002318661	0.000085341
	K= 56	0.002095092	0.000708766	-0.001595577	-0.001219098	0.000954181	0.001428567	-0.000308838
	K= 63	-0.005731668						
426.	K= 0	0.499998689	0.318142056	0.000001216	-0.105601072	-0.000001209	0.062827885	0.000001201
	K= 7	-0.044311248	-0.000001117	0.033884559	0.000001106	-0.027140044	-0.000001061	0.022383388
	K= 14	0.000001080	-0.018824298	-0.000001021	0.016045362	0.000000961	-0.013805296	-0.000000948
	K= 21	0.011954956	0.000001218	-0.010397173	-0.000000869	0.009066477	0.000000916	-0.007916607
	K= 28	-0.000000888	0.006914314	0.000000893	-0.006034799	-0.000000684	0.005258948	0.000000654
	K= 35	-0.004572477	-0.000000658	0.003963817	0.000000486	-0.003423575	-0.000000502	0.002943710
	K= 42	0.000000433	-0.002518371	-0.000000402	0.002142058	0.000000329	-0.001809163	-0.000000280
	K= 49	0.001516697	0.000000230	-0.001259956	-0.000000249	0.001036049	0.000000174	-0.000841771
	K= 56	-0.000000150	0.000674355	0.000000120	-0.000531127	-0.000000134	0.000409742	0.000000111
	K= 63	-0.000677263						
427.	K= 0	0.510024667	0.317945600	-0.009991251	-0.105014980	0.009891283	0.061862431	-0.009726737
	K= 7	-0.042983126	0.009500533	0.032216635	-0.009216562	-0.025160573	0.008879978	0.020125348
	K= 14	-0.008496605	-0.016324881	0.008072935	0.013344549	-0.007615902	-0.010945033	0.007133015
	K= 21	0.008978654	-0.006631374	-0.007347926	0.006119110	0.005986843	-0.005602859	-0.004847251
	K= 28	0.005089726	0.003893208	-0.004586041	-0.003096499	0.004097648	0.002434684	-0.003629566
	K= 35	-0.001888884	0.003185937	0.001442740	-0.002770389	-0.001082153	0.002385410	0.000794827
	K= 42	-0.002032775	-0.000569518	0.001713404	0.000396200	-0.001427508	-0.000265798	0.001174872
	K= 49	0.000170881	-0.000953903	-0.000103684	0.000763673	0.000058330	-0.000602110	-0.000029215
	K= 56	0.000467249	0.000010638	-0.000358273	0.000004628	0.000281373	-0.000035457	-0.000351303
	K= 63	-0.000245832						
428.	K= 0	0.499999642	0.318222940	0.000000214	-0.105842769	-0.000000200	0.063228011	0.000000176
	K= 7	-0.044866458	-0.000000094	0.034590442	0.000000111	-0.027991150	-0.000000149	0.023372747
	K= 14	0.000000160	-0.019943789	-0.000000170	0.017286092	0.000000124	-0.015157580	-0.000000108
	K= 21	0.013408232	0.000000448	-0.011940483	-0.000000160	0.010687843	0.000000262	-0.009604044

NO.	INDEX	HO(K)	HO(K+1)	HO(K+2)	HO(K+3)	HO(K+4)	HO(K+5)	HO(K+6)
	K= 28	-0.000000313	0.008656200	0.000000294	-0.007818621	-0.000000136	0.007071808	0.000000196
	K= 35	-0.006401207	-0.000000230	0.005795438	0.000000029	-0.005246956	-0.000000128	0.004749157
	K= 42	0.000000171	-0.004293948	-0.000000218	0.003877097	0.000000051	-0.003494119	-0.000000093
	K= 49	0.003142071	0.000000038	-0.002821778	-0.000000080	0.002525863	0.000000055	-0.002249668
	K= 56	-0.000000142	0.002002013	0.000000039	-0.001769752	-0.000000241	0.001558987	-0.000000146
	K= 63	-0.005731646						
429.	K= 0	0.511626661	0.317974985	-0.011598181	-0.105102420	0.011511907	0.062004667	-0.011368576
	K= 7	-0.043174364	0.011171129	0.032449029	-0.010922201	-0.025425337	0.010623790	0.020411696
	K= 14	-0.010281362	-0.016621456	0.009898495	0.013639715	-0.009479981	-0.011226639	0.009031065
	K= 21	0.009235237	-0.008557163	-0.007568866	0.008064199	0.006162480	-0.007557455	-0.004969530
	K= 28	0.007042766	0.003956337	-0.006524790	-0.003096149	0.006008632	0.002367398	-0.005500678
	K= 35	-0.001753913	0.005006716	0.001245052	-0.004525434	-0.000822562	0.004065774	0.000479929
	K= 42	-0.003628034	-0.000205374	0.003215707	-0.000009982	-0.002830833	0.000174830	0.002475104
	K= 49	-0.000297013	-0.002149693	0.000385475	0.001855813	-0.000449957	-0.001595746	0.000503130
	K= 56	0.001375097	-0.000568400	-0.001215407	0.000704201	0.001231069	-0.001142005	-0.002904790
	K= 63	-0.002009645						
430.	K= 0	0.521681190	0.317418158	-0.021572381	-0.103447258	0.021245260	0.059292410	-0.020706333
	K= 7	-0.039466795	0.019976284	0.027837742	-0.019068219	-0.020017434	0.018006861	0.014331538
	K= 14	-0.016817685	-0.010003746	0.015530188	0.006626848	-0.014173530	-0.003963828	0.012777656
	K= 21	0.001865407	-0.011371046	-0.000227439	0.009981599	-0.001024928	-0.008634318	0.001952187
	K= 28	0.007351264	-0.002604577	-0.006150845	0.003026052	0.005047083	-0.003255622	-0.004050240
	K= 35	0.003329532	0.003166301	-0.003280407	-0.002397424	0.003137811	0.001742184	-0.002928184
	K= 42	-0.001195926	0.002674878	0.000751236	-0.002398239	-0.000398852	0.002114829	0.000127136
	K= 49	-0.001839388	0.000076434	0.001583609	-0.000227510	-0.001361234	0.000341815	0.001189470
	K= 56	-0.000440998	-0.001111355	0.000549029	0.001278750	-0.000610368	-0.002496959	-0.002170041
	K= 63	-0.000756333						
431.	K= 0	0.636223793	0.289416075	-0.119879246	-0.029854950	0.077978134	-0.033746380	-0.028144047
	K= 7	0.043585207	-0.010612573	-0.025461599	0.027073260	0.000155534	-0.022039335	0.016472675
	K= 14	0.005795240	-0.018160857	0.008955799	0.008524250	-0.014128659	0.003551063	0.009363357
	K= 21	-0.010230251	-0.000188999	0.008945554	-0.006709047	-0.002554223	0.007742938	-0.003741824
	K= 28	-0.003799687	0.006133586	-0.001428821	-0.004176810	0.004417676	0.000207474	-0.003936429
	K= 35	0.002817664	0.001213258	-0.003314212	0.001478877	0.001685509	-0.002515907	0.000473649
	K= 42	0.001752157	-0.001704184	-0.000187416	0.001550155	-0.000992244	-0.000541182	0.001207559
	K= 49	-0.000442525	-0.000654058	0.000828726	-0.000074125	-0.000604152	0.000488396	0.000127458
	K= 56	-0.000468427	0.000230045	0.000197719	-0.000316303	0.000078937	0.000198399	-0.000321286
	K= 63	-0.000328518						

NO.	INDEX	HO(K)	HO(K+1)	HO(K+2)	HO(K+3)	HO(K+4)	HO(K+5)	HO(K+6)
432.	K= C	0.638031900	0.288736939	-0.121181190	-0.028192334	0.078033626	-0.035464890	-0.026896641
	K= 7	0.044374388	-0.012478717	-0.024833258	0.028484721	-0.001569638	-0.022139650	0.018302955
	K= 14	0.004474968	-0.018988945	0.010941580	0.007807780	-0.015575312	0.005413666	0.C09355284
	K= 21	-0.012100507	0.001297285	0.C09646125	-0.0087526C3	-0.001633148	0.0C9050097	-0.005696658
	K= 28	-0.003544398	0.007865705	-0.003058459	-0.004588161	0.006345578	-0.000922151	-0.004923590
	K= 35	0.C04702967	C.000676328	-0.C04716471	0.003108864	0.001746500	-0.004129451	0.C01690655
	K= 42	0.002330963	-0.003321353	C.000537818	0.002512921	-0.0C2430848	-0.000314518	0.002381995
	K= 49	-0.001574700	-0.000862327	0.002047598	-0.000837637	-0.001136821	0.001620900	-C.000277927
	K= 56	-0.001209237	0.001228685	C.000080941	-0.001256929	0.001118768	0.000448879	-0.003085854
	K= 63	-0.002687166						
433.	K= C	0.647556245	0.284582019	-0.127064645	-0.018930379	0.07582432C	-0.042734765	-C.C18395975
	K= 7	0.044187326	-0.020702895	-0.017532025	0.030253232	-0.010257296	-0.016376417	0.021823112
	K= 14	-0.004174009	-0.014980581	0.015897941	-0.000324555	-0.013402283	0.C11402205	C.002146769
	K= 21	-0.0117C7436	0.007873148	0.003675365	-0.009958573	0.005079534	0.004513644	-0.008224580
	K= 28	0.002885129	0.004835028	-0.006562673	0.001204729	0.0047734C4	-0.005022638	-C.000030313
	K= 35	0.004437301	-0.003644661	-0.000880175	0.003919248	-0.002457817	-0.001404562	0.003298143
	K= 42	-0.001477751	-0.001662402	0.002641212	-0.000708393	-0.001713089	0.002003712	-0.000142377
	K= 49	-0.001616553	0.001431235	0.000240036	-0.001437105	0.0C0960942	0.000478241	-0.001256649
	K= 56	0.C00617149	0.000675778	-0.001225917	0.000324609	0.001348840	-0.001610662	-0.C03143496
	K= 63	-0.001348101						
434.	K= 0	0.823508382	0.167480528	-0.142119765	0.105049431	-0.062850535	0.022612356	0.C09556472
	K= 7	-0.029721919	0.036758415	-0.032304551	0.020095751	-0.004880045	-0.008789163	0.C17578345
	K= 14	-0.019985288	0.016426083	-0.008834105	-0.000072709	0.007628266	-0.011928122	0.012240183
	K= 21	-0.C09043064	0.003728994	0.001907174	-0.006225985	0.008181233	-0.0C7538691	0.004834641
	K= 28	-0.001121499	-0.002401637	0.004751947	-0.005416743	0.004438590	-0.002327589	-C.000149377
	K= 35	0.002226549	-0.003362012	0.003364587	-C.002400163	0.00C892147	0.0C0640034	-0.C01747796
	K= 42	0.002175209	-0.C01905619	0.001130091	-0.000158254	-0.000692505	C.001193431	-C.C01257999
	K= 49	0.000944523	-0.000414194	-C.000135550	0.000537655	-0.000700814	0.000624022	-0.000379259
	K= 56	0.000075586	0.000182306	-0.000326845	C.000342262	-0.00025945C	0.000136197	-C.000033002
	K= 63	-0.C00503029						
435.	K= 0	0.825855970	0.165523589	-0.141205013	0.105481982	-0.064487875	0.024911366	0.C07358436
	K= 7	-0.028354559	0.036676161	-0.033536494	0.022236768	-0.007224962	-0.007011853	0.C16952816
	K= 14	-0.020716488	0.018273897	-0.011194181	0.002030453	0.006463770	-0.012075089	0.013643943
	K= 21	-0.011242993	0.006012045	C.000272974	-0.005755551	0.C09CC938C	-0.00938366C	0.007095300
	K= 28	-0.003075493	-0.001364338	C.004937828	-0.006737936	0.006452080	-0.004384987	C.C01309056
	K= 35	0.001801234	-0.004066169	0.004937891	-0.004321862	0.002554878	-0.000262626	-0.C01847280

NO.	INDEX	HO(K)	HO(K+1)	HO(K+2)	HO(K+3)	HO(K+4)	HO(K+5)	HO(K+6)
	K= 42	0.003197263	-0.003489242	0.002759666	-0.001333857	-0.000302484	0.001659465	-0.002383447
	K= 49	0.002344445	-0.001645048	0.000567634	0.000534262	-0.001347725	0.001680983	-0.001507657
	K= 56	0.000941235	-0.000189129	-0.000527396	0.001069010	-0.001381458	0.001533176	-0.001661178
	K= 63	-0.004132908						
436.	K= 0	0.832920432	0.159438908	-0.137785017	0.105664253	-0.068201900	0.031104647	0.000419568
	K= 7	-0.022593651	0.033667203	-0.034068495	0.026104901	-0.013303921	-0.000438984	0.011703886
	K= 14	-0.018202104	0.019113969	-0.015065808	0.007782049	0.000467824	-0.007485688	0.011668630
	K= 21	-0.012325704	0.009736426	-0.004966378	-0.000498255	0.005172566	-0.007949401	0.008338276
	K= 28	-0.006519526	0.003223433	0.000523283	-0.003692915	0.005525794	-0.005699247	0.004362740
	K= 35	-0.002042623	-0.000535706	0.002663852	-0.003835125	0.003852094	-0.002850758	0.001220470
	K= 42	0.000528004	-0.001917237	0.002620912	-0.002535445	0.001785761	-0.000659840	-0.000495434
	K= 49	0.001365626	-0.001751215	0.001621761	-0.001073132	0.000312661	0.000436538	-0.000983436
	K= 56	0.001220369	-0.001127702	0.000751869	-0.000159495	-0.000614498	0.001606311	-0.002938172
	K= 63	-0.003147978						
437.	K= 0	0.127685606	0.124276817	0.114378512	0.098937452	0.079410315	0.057598364	0.035445120
	K= 7	0.014823146	-0.002665319	-0.015848663	-0.024090320	-0.027325217	-0.026027571	-0.021116022
	K= 14	-0.013811387	-0.005466882	0.002606463	0.009296492	0.013810243	0.015744083	0.015098237
	K= 21	0.012237072	0.007804323	0.002607671	-0.002509714	-0.006791994	-0.009671584	-0.010835402
	K= 28	-0.010249779	-0.008143347	-0.004953306	-0.001245286	0.002379826	0.005317587	0.007337123
	K= 35	0.008033145	0.007446948	0.005755268	0.003290593	0.000480884	-0.002221364	-0.004409086
	K= 42	-0.005779698	-0.006174192	-0.005592663	-0.004184525	-0.002216442	-0.000024846	0.002039861
	K= 49	0.003667623	0.004633777	0.004828483	0.004266843	0.003079321	0.001485078	-0.000246793
	K= 56	-0.001841482	-0.003061033	-0.003738861	-0.003801354	-0.003273854	-0.002271202	-0.000974943
	K= 63	0.000398415	0.001632771	0.002545644	0.003014543	0.002992261	0.002510093	0.001668493
	K= 70	0.000617687	-0.000468430	-0.001420602	-0.002099687	-0.002416787	-0.002343853	-0.001914632
	K= 77	-0.001215808	-0.000370572	0.000482430	0.001211435	0.001711610	0.001919538	0.001820611
	K= 84	0.001448326	0.000876098	0.000203893	-0.000458990	-0.001011332	-0.001375108	-0.001506028
	K= 91	-0.001398472	-0.001083700	-0.000622814	-0.000095546	0.000413174	0.000826431	0.001087141
	K= 98	0.001165153	0.001060239	0.000800151	0.000434617	0.000026224	-0.000359605	-0.000665387
	K=105	-0.000849736	-0.000892075	-0.000794908	-0.000581534	-0.000291926	0.000025254	0.000320414
	K=112	0.000549713	0.000681465	0.000700596	0.000608679	0.000422094	0.000170698	-0.000110874
	K=119	-0.000385171	-0.000619921	-0.000790467	-0.000883233	-0.000895907	-0.000836806	-0.000722054
	K=126	-0.000572828	-0.000746392					
438.	K= 0	0.254608870	0.228292525	0.159027398	0.071636260	-0.004598983	-0.048038889	-0.052670371
	K= 7	-0.028602578	0.004569080	0.027829219	0.031198807	0.016764924	-0.004519843	-0.019921210
	K= 14	-0.021858491	-0.011180755	0.004451450	0.015625309	0.016566746	0.007911935	-0.004365198

NO.	INDEX	H0(K)	H0(K+1)	H0(K+2)	H0(K+3)	H0(K+4)	H0(K+5)	H0(K+6)
	K= 21	-0.012874838	-0.013121303	-0.005760979	0.004261520	0.010926250	0.010675319	0.004239399
	K= 28	-0.004141912	-0.009447716	-0.008834671	-0.003111108	0.004007768	0.008269358	0.007391393
	K= 35	0.002247938	-0.003860296	-0.007295176	-0.006225191	-0.001573665	0.003701388	0.006467730
	K= 42	0.005262028	0.001040324	-0.003532741	-0.005750682	-0.004454255	-0.000616611	0.003355361
	K= 49	0.005119212	0.003768299	0.000279408	-0.003171101	-0.004556242	-0.003180171	-0.000011053
	K= 56	0.002983967	0.004052579	0.002675677	-0.000197935	-0.002792659	-0.003597381	-0.002239618
	K= 63	0.000359688	0.002601139	0.003186052	0.001863691	-0.000480505	-0.002409938	-0.002813212
	K= 70	-0.001539537	0.000567206	0.002221119	0.002475579	0.001260780	-0.000625308	-0.002035994
	K= 77	-0.002169867	-0.001022058	0.000659239	0.001856007	0.001893943	0.000818645	-0.000673348
	K= 84	-0.001682268	-0.001645239	-0.000646424	0.000671116	0.001516289	0.001422358	0.000501733
	K= 91	-0.000656015	-0.001358567	-0.001223170	-0.000381052	0.000631126	0.001210649	0.001046081
	K= 98	0.000281003	-0.000599331	-0.001073265	-0.000889705	-0.000198375	0.000563885	0.000947475
	K=105	0.000752280	0.000129515	-0.000528822	-0.000835716	-0.000632542	-0.000070134	0.000500360
	K=112	0.000742442	0.000530946	0.000012923	-0.000491275	-0.000682153	-0.000453091	0.000055114
	K=119	0.000541147	0.000713868	0.000448269	-0.000156992	-0.000842240	-0.001326245	-0.001441456
	K=126	-0.001197552	-0.000999416					
439.	K= 0	0.380997419	0.296294570	0.108178675	-0.046037454	-0.079231024	-0.018677846	0.041363176
	K= 7	0.039175723	-0.005936962	-0.034225762	-0.017726220	0.016148724	0.025499534	0.003551270
	K= 14	-0.019345809	-0.016214814	0.005758882	0.018166989	0.007406652	-0.011035018	-0.014247872
	K= 21	0.000033113	0.012871750	0.008926831	-0.005472746	-0.011957839	-0.003356907	0.008611511
	K= 28	0.009120598	-0.001531616	-0.009493481	-0.005258448	0.005093385	0.008465685	0.001233734
	K= 35	-0.007006943	-0.006094642	0.002231703	0.007267717	0.003051969	-0.004640892	-0.006142057
	K= 42	0.000000711	0.005760759	0.004080974	-0.002516957	-0.005619302	-0.001619243	0.004136544
	K= 49	0.004459124	-0.000728782	-0.004716650	-0.002663273	0.002552819	0.004324034	0.000665688
	K= 56	-0.003604710	-0.003190299	0.001132433	0.003815606	0.001644982	-0.002430921	-0.003282163
	K= 63	-0.000041075	0.003068607	0.002222805	-0.001313916	-0.003032837	-0.000918571	0.002207999
	K= 70	0.002438396	-0.000347461	-0.002548194	-0.001486987	0.001344423	0.002359799	0.000413328
	K= 77	-0.001929392	-0.001762980	0.000563015	0.002062465	0.000939416	-0.001272375	-0.001790134
	K= 84	-0.000077492	0.001628978	0.001233319	-0.000652868	-0.001624147	-0.000543293	0.001138404
	K= 91	0.001320802	-0.000127685	-0.001330201	-0.000827400	0.000658046	0.001243688	0.000269085
	K= 98	-0.000973453	-0.000944411	0.000239011	0.001053771	0.000525665	-0.000611820	-0.000926394
	K=105	-0.000085795	0.000805545	0.000651747	-0.000292010	-0.000817464	-0.000304686	0.000552807
	K=112	0.000677538	-0.000044463	-0.000674968	-0.000433179	0.000345816	0.000667471	0.000129728
	K=119	-0.000586603	-0.000563764	0.000223021	0.000839415	0.000441411	-0.000789325	-0.001845054
	K=126	-0.001926261	-0.001336729					
440.	K= 0	0.507060111	0.318201303	-0.007055368	-0.105778277	0.007040001	0.063121080	-0.007014796

NO.	INDEX	HO(K)	HO(K+1)	HO(K+2)	HO(K+3)	HO(K+4)	HO(K+5)	HO(K+6)
	K= 7	-0.044717688	0.006979521	0.034400526	-0.006934211	-0.027760368	0.006879222	0.023101944
	K= 14	-0.006814856	-0.019634515	0.006741229	0.016939394	-0.006658699	-0.014774546	0.006567668
	K= 21	0.012990579	-0.006468110	-0.011489689	0.006360441	0.010205552	-0.006245375	-0.009092007
	K= 28	0.006123334	0.008115597	-0.005994458	-0.007251039	0.005859639	0.006480236	-0.005718686
	K= 35	-0.005788047	0.005572621	0.005163535	-0.005421702	-0.004597552	0.005266886	0.004083268
	K= 42	-0.005108230	-0.003614431	0.004946362	0.003186455	-0.004781537	-0.002794699	0.004615113
	K= 49	0.002436466	-0.004447088	-0.002108808	0.004277602	0.001808950	-0.004107822	-0.001534491
	K= 56	0.003938157	0.001284253	-0.003768465	-0.001056153	0.003599744	0.000848095	-0.003432781
	K= 63	-0.000659752	0.003266687	0.000488674	-0.003103414	-0.000334560	0.002942685	0.000195785
	K= 70	-0.002785402	-0.000072182	0.002631252	-0.000037534	-0.002480614	0.000134228	0.002333578
	K= 77	-0.000219131	-0.002190355	0.000293455	0.002051749	-0.000357600	-0.001918585	0.000411840
	K= 84	0.001790028	-0.000456077	-0.001665630	0.000493004	0.001545759	-0.000523507	-0.001432567
	K= 91	0.000546214	0.001324575	-0.000561547	-0.001219603	0.000574197	0.001122832	-0.000579131
	K= 98	-0.001029110	0.000581523	0.000941626	-0.000579600	-0.000858895	0.000574835	0.000781318
	K=105	-0.000567777	-0.000708533	0.000559304	0.000640452	-0.000550476	-0.000577138	0.000542636
	K=112	0.000518422	-0.000537541	-0.000464457	0.000538340	0.000415781	-0.000550518	-0.000374510
	K=119	0.000584989	0.000347482	-0.000666814	-0.000360832	0.000866827	0.000548710	-0.001469366
	K=126	-0.002608716	-0.001786912					
441.	K= 0	0.632826686	0.290968478	-0.117890894	-0.033241108	0.079072952	-0.031316530	-0.031484373
	K= 7	0.044165280	-0.007728085	-0.028687868	0.027051043	0.003490343	-0.025036339	0.015746884
	K= 14	0.009533267	-0.020766575	0.007438183	0.012556300	-0.016147994	0.001196610	0.013510522
	K= 21	-0.011461191	-0.003354738	0.012966283	-0.006975882	-0.006418634	0.011354487	-0.002930552
	K= 28	-0.008156989	0.009045705	0.000484215	-0.008742388	0.006371159	0.003137973	-0.008371726
	K= 35	0.003624126	0.004965540	-0.007266454	0.001052130	0.005968470	-0.005661283	-0.001151761
	K= 42	0.006208878	-0.003790218	-0.002853815	0.005799271	-0.001870247	-0.003984082	0.004887879
	K= 49	-0.000089817	-0.004531380	0.003644552	0.001406176	-0.004539605	0.002241708	0.002519164
	K= 56	-0.004093986	0.000840923	0.003201646	-0.003309557	-0.000420687	0.003454537	-0.002317503
	K= 63	-0.001439933	0.003319148	-0.001247784	-0.002152801	0.002869236	-0.000221106	-0.002534839
	K= 70	0.002198696	0.000666801	-0.002597608	0.001409227	0.001344823	-0.002383952	0.000601040
	K= 77	0.001776078	-0.001958488	-0.000138322	0.001954018	-0.001400499	-0.000743544	0.001900821
	K= 84	-0.000788155	-0.001172930	0.001658146	-0.000193741	-0.001407282	0.001281461	0.000320271
	K= 91	-0.001453755	0.000835006	0.000713049	-0.001340050	0.000375838	0.000962587	-0.001102109
	K= 98	-0.000041437	0.001064837	-0.000791792	-0.000380857	0.001036435	-0.000451455	-0.000615788
	K=105	0.000904936	-0.000127674	-0.000744539	0.000703169	0.000147622	-0.000774204	0.000470826
	K=112	0.000356831	-0.000727073	0.000241267	0.000499375	-0.000635862	0.000035279	0.000598275
	K=119	-0.000540608	-0.000156816	0.000726388	-0.000477475	-0.000475292	0.001146105	-0.000245680

NO.	INDEX	HO(K)	HO(K+1)	HO(K+2)	HO(K+3)	HO(K+4)	HO(K+5)	HO(K+6)
	K=126	-0.002992440	-0.002386541					
442.	K= 0	0.758214474	0.219175398	-0.158882976	0.080535769	-0.008187387	-0.038758252	0.052239556
	K= 7	-0.037234884	0.008105773	0.018441159	-0.030488562	0.025084216	-0.007971637	-0.010483302
	K= 14	0.020880047	-0.019146189	0.007786877	0.006196998	-0.015336435	0.015488636	-0.007554919
	K= 21	-0.003514294	0.011658065	-0.012919180	0.007279713	0.001691122	-0.009002376	0.010956332
	K= 28	-0.006965447	-0.000393573	0.006977700	-0.009369928	0.006617554	-0.000551717	-0.005378246
	K= 35	0.008038189	-0.006241772	0.001244171	0.004085448	-0.006891422	0.005843703	-0.001745635
	K= 42	-0.003026500	0.005887464	-0.005429272	0.002098418	0.002153052	-0.004999831	0.005004581
	K= 49	-0.002332350	-0.001431250	0.004210565	-0.004575767	0.002469996	0.000838029	-0.003509061
	K= 56	0.004148703	-0.002529202	-0.000354813	0.002886117	-0.003728192	0.002524161	-0.000034062
	K= 63	-0.002335237	0.003319506	-0.002467879	0.000339936	0.001851833	-0.002927091	0.002371089
	K= 70	-0.000573769	-0.001430619	0.002554173	-0.002243254	0.000745656	0.001067668	-0.002204638
	K= 77	0.002092794	-0.000863661	-0.000759029	0.001880467	-0.001927415	0.000936300	0.000500414
	K= 84	-0.001584381	0.001752661	-0.000969523	-0.000287824	0.001315232	-0.001574152	0.000972026
	K= 91	0.000115664	-0.001074169	0.001397807	-0.000950845	0.000020404	0.000863096	-0.001227301
	K= 98	0.000909581	-0.000123389	-0.000678174	0.001064150	-0.000856118	0.000201436	0.000518993
	K=105	-0.000915146	0.000794339	-0.000257119	-0.000382100	0.000777643	-0.000734032	0.000300362
	K=112	0.000265641	-0.000656974	0.000682916	-0.000343226	-0.000159398	0.000564219	-0.000665097
	K=119	0.000418525	0.000055858	-0.000536686	0.000792354	-0.000649585	0.000017476	0.001122868
	K=126	-0.002727413	-0.003184648					

MISCELLANEOUS DESIGNS

443.	K= 0	0.300435424	0.231769264	0.101007164	0.019505583	
444.	K= 0	0.298446357	0.236985445	0.113026738	0.025764439	
445.	K= 0	0.518231094	0.286629915	-0.010340415	-0.037904803	
446.	K= 0	0.556332290	0.293137670	-0.040416054	-0.055887539	
447.	K= 0	0.735510826	0.217733681	-0.116530359	0.033540796	
448.	K= 0	0.786520839	0.189915836	-0.131010234	0.072833419	
449.	K= 0	0.249418736	0.208467007	0.119080067	0.042757813	0.007485386
450.	K= 0	0.241636097	0.207769096	0.129581034	0.054480735	0.012350731
451.	K= 0	0.435513854	0.288325429	0.047376189	-0.039550375	-0.016408097
452.	K= 0	0.459859371	0.300630152	0.034299154	-0.062880158	-0.026978765
453.	K= 0	0.613703072	0.278669775	-0.078474224	-0.027444836	0.022897463

NO.	INDEX	HO(K)	HO(K+1)	HO(K+2)	HO(K+3)	HO(K+4)	HO(K+5)	HO(K+6)
454.	K= 0	0.658905923	0.268680930	-0.113332748	-0.006430909	0.046629429		
455.	K= 0	0.790445209	0.185546517	-0.126866698	0.063228428	-0.019630779		
456.	K= 0	0.835912108	0.153194368	-0.123813331	0.084555447	-0.056892391		
457.	K= 0	0.211677492	0.186017692	0.124887824	0.061686758	0.020498227	0.003570423	
458.	K= 0	0.201494038	0.181437433	0.131303668	0.074030340	0.030199159	0.007282045	
459.	K= 0	0.373788774	0.276697695	0.090393662	-0.020233043	-0.028512996	-0.007739607	
460.	K= 0	0.530769467	0.299757242	-0.023408707	-0.060911711	0.009248912	0.012429178	
461.	K= 0	0.564803064	0.301974893	-0.054488730	-0.065949976	0.034337204	0.026724793	
462.	K= 0	0.724154234	0.236452758	-0.141298056	0.042218193	0.016970959	-0.041420836	
463.	K= 0	0.827567279	0.158827782	-0.123295069	0.078802288	-0.039263289	0.013644129	
464.	K= 0	0.867140591	0.127024174	-0.110687256	0.087078035	-0.060632378	0.048646625	
465.	K= 0	0.182970941	0.166136920	0.123647511	0.073969662	0.034127239	0.011118203	0.002014632
466.	K= 0	0.172090590	0.159434080	0.126198769	0.084039748	0.045572307	0.018776029	0.004933503
467.	K= 0	0.325677574	0.259630799	0.118449926	0.007138640	-0.028414764	-0.017994385	-0.004148964
468.	K= 0	0.334513962	0.268874407	0.123733222	0.000719694	-0.044378638	-0.031844113	-0.009361513
469.	K= 0	0.465952158	0.302778125	0.029126141	-0.066245914	-0.017655220	0.014692679	0.006827705
470.	K= 0	0.490812778	0.310338676	0.009053759	-0.084142089	-0.008023739	0.036053352	0.016313221
471.	K= 0	0.600886881	0.290519774	-0.079530358	-0.043341391	0.037688576	0.001596666	-0.009876568
472.	K= 0	0.636383891	0.283205271	-0.109549999	-0.025514480	0.055067934	-0.019940842	-0.026459657
473.	K= 0	0.728483140	0.231828690	-0.137513936	0.042316947	0.012579754	-0.022920720	0.011967447
474.	K= 0	0.768826306	0.207621694	-0.146872580	0.073294044	-0.012972962	-0.018665701	0.038182098
475.	K= 0	0.853946507	0.137702048	-0.115019202	0.084164619	-0.052703395	0.026907865	-0.010525078
476.	K= 0	0.888546228	0.107985377	-0.098087609	0.083156407	-0.065227211	0.046607323	-0.043707237
477.	K= 0	0.904083490	0.093691230	-0.087287188	0.077359319	-0.064945698	0.051264718	-0.037558265
	K= 7	0.040433578						
478.	K= 0	0.825660408	0.164069295	-0.135788620	0.096265197	-0.054389805	0.018540800	0.005687609
	K= 7	-0.016625434	0.034410324					
479.	K= 0	0.757057548	0.217885554	-0.152770519	0.072677195	-0.005334955	-0.031585407	0.036682032
	K= 7	-0.022200171	0.005145025	0.025972493				
480.	K= 0	0.108210504	0.104710400	0.094802737	0.080118120	0.062928736	0.045622945	0.030205142
	K= 7	0.017953489	0.009307563	0.003980927	0.001264475			
481.	K= 0	0.202455401	0.186145365	0.142933667	0.087239861	0.035552330	-0.000409443	-0.017262612
	K= 7	-0.019038126	-0.013191104	-0.006323632	-0.001873860			
482.	K= 0	0.277065635	0.239296079	0.146585405	0.046149269	-0.019887276	-0.038266685	-0.024486128
	K= 7	-0.003986418	0.006977722	0.007057704	0.003027442			
483.	K= 0	0.298902571	0.252830446	0.142491817	0.029798422	-0.034795951	-0.042307075	-0.018777177

NO.	INDEX	HO(K)	HO(K+1)	HO(K+2)	HO(K+3)	HO(K+4)	HO(K+5)	HO(K+6)
	K= 7	0.004054230	0.011686835	0.008009769	0.002557010			
484.	K= 0	0.314399302	0.262919664	0.140386522	0.017608266	-0.048102994	-0.047872979	-0.013932191
	K= 7	0.015161481	0.022475101	0.014433350	0.004723672			
485.	K= 0	0.284085989	0.246092618	0.151188254	0.044668935	-0.029294085	-0.051468987	-0.032914601
	K= 7	-0.001263241	0.019615393	0.021970563	0.014361747			
486.	K= 0	0.248751402	0.223369556	0.156816065	0.073431671	0.001205845	-0.040158991	-0.046381611
	K= 7	-0.027733859	-0.001758490	0.016091503	0.045741729			
487.	K= 0	0.329700232	0.271629393	0.135315716	0.003721945	-0.058898594	-0.047389459	-0.003415152
	K= 7	0.028289065	0.031807221	0.018498871	0.005590465			
488.	K= 0	0.368612468	0.286550283	0.109118760	-0.029438566	-0.059631702	-0.019413520	0.016539190
	K= 7	0.017449725	0.002218184	-0.005397983	-0.003300671			
489.	K= 0	0.395254076	0.296557546	0.091624796	-0.050327741	-0.059885353	-0.004281804	0.026404127
	K= 7	0.014493801	-0.004968692	-0.008827817	-0.003415945			
490.	K= 0	0.461226583	0.310474575	0.035837550	-0.084451258	-0.028123934	0.032956127	0.018340964
	K= 7	-0.011445083	-0.009454913	0.002715680	0.003536967			
491.	K= 0	0.490172803	0.313343704	0.009455808	-0.091913104	-0.008396961	0.042193081	0.006797258
	K= 7	-0.019458979	-0.004832681	0.008221164	0.004503988			
492.	K= 0	0.553774953	0.308380723	-0.049157847	-0.079229712	0.037310921	0.027048666	-0.022998855
	K= 7	-0.007066220	0.010957096	0.000616644	-0.003748755			
493.	K= 0	0.568809032	0.306924224	-0.063221753	-0.075332522	0.048784234	0.021924026	-0.031087656
	K= 7	-0.002140534	0.015842348	-0.003375114	-0.007721614			
494.	K= 0	0.582884312	0.303086162	-0.074450552	-0.066173911	0.053592745	0.012507103	-0.030257523
	K= 7	0.003768185	0.012913030	-0.005573459	-0.005853761			
495.	K= 0	0.587605536	0.302673459	-0.079155505	-0.064770222	0.057987668	0.009958621	-0.033669967
	K= 7	0.007129915	0.014818780	-0.009741727	-0.009033635			
496.	K= 0	0.595245183	0.300874531	-0.085651219	-0.060229640	0.061760426	0.004587475	-0.034679558
	K= 7	0.011749264	0.014090981	-0.014231589	-0.010893133			
497.	K= 0	0.672613204	0.268859863	-0.132897794	0.004842177	0.052614279	-0.039830226	0.002334906
	K= 7	0.017995540	-0.013189588	0.000518730	0.007445376			
498.	K= 0	0.696014345	0.257570982	-0.144780576	0.026378870	0.043745510	-0.050694820	0.019252542
	K= 7	0.012531068	-0.022863664	0.016464047	0.019388776			
499.	K= 0	0.758360445	0.216300726	-0.150893331	0.071538568	-0.006247908	-0.028302792	0.032261666
	K= 7	-0.018374491	0.002205060	0.006451897	-0.009119328			
500.	K= 0	0.839008987	0.152548075	-0.129138052	0.095914781	-0.059756603	0.027305335	-0.003275539
	K= 7	-0.010479454	0.014915124	-0.012902949	0.010364398			
501.	K= 0	0.916089833	0.082330167	-0.077732742	0.070543110	-0.061404325	0.051097237	-0.040445734

NO.	INDEX	HO(K)	HO(K+1)	HO(K+2)	HO(K+3)	HO(K+4)	HO(K+5)	HO(K+6)
	K= 7	0.030222390	-0.021065474	0.013420776	-0.010010287			
502.	K= 0	0.642279804	0.284841895	-0.120191574	-0.022846971	0.068701923	-0.031673092	-0.018619727
	K= 7	0.031000935	-0.009288069	-0.013355147	0.020507604	0.014782034		
503.	K= 0	0.182097971	0.171391129	0.141797185	0.100105584	0.055279914	0.015843924	-0.012341063
	K= 7	-0.027210355	-0.030292001	-0.025453482	-0.017200664	-0.009208173	-0.003760833	
504.	K= 0	0.200096130	0.186075926	0.147836030	0.095556736	0.042269807	-0.000330120	-0.025347315
	K= 7	-0.032093331	-0.025195003	-0.012044571	0.000275598	0.007299021	0.018148735	
505.	K= 0	0.212398052	0.195766866	0.150929749	0.091109872	0.032705281	-0.010583393	-0.032040615
	K= 7	-0.033064481	-0.021077678	-0.005511072	0.006153177	0.010628171	0.013784751	
506.	K= 0	0.271297395	0.238371372	0.154508829	0.056034010	-0.019153252	-0.050370116	-0.041059822
	K= 7	-0.011546511	0.015613422	0.027636144	0.024603602	0.014406379	0.005306948	
507.	K= 0	0.275994956	0.241179526	0.153139174	0.051488038	-0.023251232	-0.050565414	-0.036952168
	K= 7	-0.006564133	0.016280748	0.020621285	0.010968760	-0.000623153	-0.016218789	
508.	K= 0	0.290910840	0.250466168	0.150020599	0.038940765	-0.035323851	-0.053518042	-0.029904254
	K= 7	0.003880621	0.022134796	0.018748447	0.004333321	-0.006864134	-0.013369832	
509.	K= 0	0.595192850	0.302148521	-0.087135315	-0.062482998	0.066289127	0.004683632	-0.040663213
	K= 7	0.015393194	0.018395085	-0.018392511	-0.003326386	0.020899989	0.011593979	
510.	K= 0	0.553935707	0.311921060	-0.051585943	-0.088008225	0.045116927	0.036751624	-0.036057666
	K= 7	-0.013576947	0.026398476	0.002040309	-0.018317752	0.004271235	0.019728195	0.009350702
511.	K= 0	0.243700027	0.219650745	0.156370759	0.076412320	0.005948514	-0.036198575	-0.045149468
	K= 7	-0.029508289	-0.004986335	0.013945151	0.020032801	0.014441390	0.003656736	-0.005333159
	K= 14	-0.008700356	-0.006715372	-0.002256913	0.001577411	0.003178836	0.002728142	0.001555158
512.	K= 0	0.392235339	0.298978984	0.098063529	-0.053804755	-0.072639763	-0.007063936	0.040687818
	K= 7	0.026531450	-0.012454249	-0.024758302	-0.005260270	0.013912465	0.011288963	-0.003064027
	K= 14	-0.009161700	-0.003061184	0.004143324	0.004147783	-0.000309886	-0.002818212	-0.001975275
513.	K= 0	0.475265324	0.316499770	0.024373636	-0.100766838	-0.023313738	0.055066586	0.021632183
	K= 7	-0.034042358	-0.019443899	0.021642022	0.016904093	-0.013526835	-0.014173433	0.008027051
	K= 14	0.011418436	-0.004322153	-0.008791786	0.001928220	0.006418750	-0.000505348	-0.007656638
514.	K= 0	0.487593234	0.317038417	0.012243673	-0.102337956	-0.011769470	0.057541333	0.011011753
	K= 7	-0.037217189	-0.010012582	0.025267612	0.008833859	-0.017331582	-0.007537361	0.011746675
	K= 14	0.006192386	-0.007736105	-0.004854135	0.004916210	0.003541887	-0.003596778	-0.004737057
515.	K= 0	0.498413444	0.317114770	0.001585429	-0.102560818	-0.001581979	0.057895981	0.001573287
	K= 7	-0.037679859	-0.001554038	0.025804721	0.001515738	-0.017908536	-0.001450350	0.012327224
	K= 14	0.001348621	-0.008287948	-0.001184891	0.005426582	0.000849005	-0.004382156	-0.003057431
516.	K= 0	0.508014977	0.316873252	-0.007840633	-0.101861298	0.007340122	0.056821294	-0.006558400
	K= 7	-0.036349732	0.005573459	0.024363037	-0.004476890	-0.016499620	0.003365457	0.011073709

NO.	INDEX	HO(K)	HO(K+1)	HO(K+2)	HO(K+3)	HO(K+4)	HO(K+5)	HO(K+6)
	K= 14	-0.002336114	-0.007278603	0.001495957	0.004709482	-0.001097558	-0.004272535	-0.002051829
517.	K= 0	0.516601563	0.316409349	-0.016218163	-0.100534201	0.015113160	0.054801270	-0.013417806
	K= 7	-0.033892650	0.011321478	0.021757197	-0.009042747	-0.014014821	0.006802026	0.008925859
	K= 14	-0.004787106	-0.005593989	0.003175737	0.003521644	-0.002346221	-0.003854788	-0.001426050
518.	K= 0	0.539899647	0.314500093	-0.038813177	-0.095058739	0.035710081	0.046470575	-0.031025168
	K= 7	-0.023735303	0.025380827	0.010924891	-0.019468650	-0.003590130	0.013917476	-0.000251088
	K= 14	-0.009195045	0.001834700	0.005549531	-0.002092906	-0.003001264	0.001997550	0.002495294
519.	K= 0	0.547507524	0.313601673	-0.046090506	-0.092503190	0.042059455	0.042641595	-0.036026619
	K= 7	-0.019172449	0.028859481	0.006208636	-0.021496732	0.000778861	0.014763929	-0.003934901
	K= 14	-0.009233467	0.004697792	0.005151447	-0.004219480	-0.002407610	0.004151080	0.003416603
520.	K= 0	0.596292257	0.302735984	-0.089174509	-0.063221931	0.070120990	0.003510078	-0.045020770
	K= 7	0.019444577	0.020847853	-0.023558881	-0.002948874	0.017859329	-0.006586358	-0.009218406
	K= 14	0.008886226	0.002109976	-0.006921206	0.001791853	0.003714555	-0.003702834	-0.003813887
521.	K= 0	0.644719243	0.284929454	-0.123740315	-0.021128502	0.072746694	-0.037397258	-0.018823303
	K= 7	0.037843905	-0.014609832	-0.015431345	0.021363750	-0.004704639	-0.011516947	0.011510920
	K= 14	-0.000231028	-0.007672504	0.005479530	0.001289753	-0.004530262	0.003010233	0.004252028
522.	K= 0	0.692717314	0.260786295	-0.146801531	0.024911806	0.049551249	-0.057699427	0.021756638
	K= 7	0.017539054	-0.031134561	0.017279502	0.005360264	-0.017151635	0.012382105	0.000365768
	K= 14	-0.008893024	0.007921889	-0.001219917	-0.004149385	0.004621830	-0.002053394	-0.004731599
523.	K= 0	0.740144312	0.231114984	-0.156591237	0.065555778	0.009361524	-0.047059152	0.045734532
	K= 7	-0.020294834	-0.007996477	0.023109559	-0.020785246	0.007492274	0.006065812	-0.012101728
	K= 14	0.009398829	-0.002179114	-0.003952883	0.005785871	-0.003808574	0.000824740	0.005251270
524.	K= 0	0.786824048	0.196908295	-0.152765393	0.093071520	-0.033514380	-0.012094703	0.036005508
	K= 7	-0.038194455	0.025117207	-0.006362837	-0.009263378	0.016627483	-0.015224811	0.008162208
	K= 14	0.000047152	-0.005692381	0.007227454	-0.005332313	0.002013876	0.000657140	-0.005805247
525.	K= 0	0.832441151	0.159392059	-0.136430264	0.102920294	-0.064817071	0.028430097	0.000940919
	K= 7	-0.020038899	0.028103437	-0.026681624	0.018919412	-0.008572891	-0.000992496	0.007502034
	K= 14	-0.010100927	0.009217255	-0.006132115	0.002399974	0.000666565	-0.002318714	0.006371357
526.	K= 0	0.876449943	0.120093107	-0.110118270	0.094738662	-0.075629056	0.054786235	-0.034256995
	K= 7	0.015860174	-0.000974228	-0.009599954	0.015693981	-0.017693035	0.016429897	-0.012979817
	K= 14	0.008479558	-0.003941573	0.000130729	0.002503372	-0.003829658	0.003982216	-0.006900173
527.	K= 0	0.918137014	0.080744445	-0.077456057	0.072191000	-0.065255165	0.057047118	-0.048014630
	K= 7	0.038634360	-0.029376298	0.020654060	-0.012824360	0.006144702	-0.000776996	-0.003220284
	K= 14	0.005887464	-0.007344998	0.007775735	-0.007403184	0.006465718	-0.005197573	0.007256541
528.	K= 0	0.957653642	0.042140272	-0.041531857	0.040535662	-0.039174542	0.037478313	-0.035489123
	K= 7	0.033251476	-0.030811708	0.028229058	-0.025550209	0.022834454	-0.020130344	0.017488796

NO.	INDEX	H0(K)	H0(K+1)	H0(K+2)	H0(K+3)	H0(K+4)	H0(K+5)	H0(K+6)
	K= 14	-0.014950946	0.012555186	-0.010333579	0.008310914	-0.006505214	0.004924871	-0.007097833
529.	K= 0	0.731157720	0.237611711	-0.157006204	0.059691578	0.018207561	-0.053941179	0.046852574
	K= 7	-0.015132647	-0.016407724	0.029961709	-0.022273991	0.002987794	0.013733223	-0.018406525
	K= 14	0.010823783	0.001766954	-0.010588340	0.011010177	-0.004550464	-0.003324303	0.007418618
	K= 21	-0.006006159	0.001191464	0.003245570	-0.004622970	0.002815808	0.000265912	-0.002435764
	K= 28	0.002805927	-0.002095076	-0.004177529				
530.	K= 0	0.763293147	0.215136886	-0.157571375	0.082583964	-0.012863968	-0.033352032	0.048467793
	K= 7	-0.036924407	0.011648636	0.012434263	-0.024715532	0.022362545	-0.009843674	-0.004652347
	K= 14	0.013769384	-0.014266342	0.007722400	0.001196559	-0.007627949	0.008939683	-0.005579874
	K= 21	0.000222382	0.004035838	-0.005325679	0.003690574	-0.000639333	-0.001972387	0.003014849
	K= 28	-0.002545350	0.001518798	0.004488744				
531.	K= 0	0.795164108	0.190682530	-0.151809871	0.097874939	-0.041664567	-0.004680250	0.033021841
	K= 7	-0.041105743	0.032459859	-0.014519449	-0.004233032	0.017056853	-0.020755738	0.016018178
	K= 14	-0.006388616	-0.003560852	0.010082599	-0.011464827	0.008262977	-0.002644170	-0.002754018
	K= 21	0.005925391	-0.006143853	0.003983948	-0.000820779	-0.001892683	0.003235101	-0.003083042
	K= 28	0.001995618	-0.000840816	-0.004819486				
532.	K= 0	0.822512925	0.168278575	-0.142399132	0.104685545	-0.061964497	0.021530200	0.010421403
	K= 7	-0.030021511	0.036341943	-0.031281687	0.018806394	-0.003779008	-0.009291824	0.017267082
	K= 14	-0.018921927	0.014939111	-0.007413585	-0.000940943	0.007628649	-0.011027772	0.010707099
	K= 21	-0.007362712	0.002446171	0.002369549	-0.005706176	0.006836001	-0.005792957	0.003243021
	K= 28	-0.000186880	-0.002390904	0.003813980	-0.003865912	0.002778849	-0.001084780	-0.006601351
	K= 35	0.001791144	-0.002259130	0.002073747	-0.001526068	0.000991322	0.004612423	
533.	K= 0	0.846383393	0.147589505	-0.130379677	0.104446888	-0.073409915	0.041422717	-0.012478821
	K= 7	-0.010226708	0.024759110	-0.030654691	0.028853670	-0.021387484	0.010897871	-0.000092088
	K= 14	-0.008752842	0.014150221	-0.015566289	0.013377842	-0.008653264	0.002825890	0.002663889
	K= 21	-0.006676115	0.008571099	-0.008273311	0.006201223	-0.003101094	-0.000169702	0.002851973
	K= 28	-0.004441872	0.004765235	-0.003966391	0.002422995	-0.000619443	-0.000986647	0.002069599
	K= 35	-0.002493127	0.002313165	-0.001732964	0.001030983	-0.000478912	-0.004863814	
534.	K= 0	0.858027220	0.137231827	-0.123590231	0.102700889	-0.077047527	0.049582087	-0.023302697
	K= 7	0.000841598	0.015875854	-0.025849458	0.029069878	-0.026431434	0.019514043	-0.010277003
	K= 14	0.000721912	0.007419873	-0.012924708	0.015207775	-0.014332820	0.010916073	-0.005942795
	K= 21	0.000546790	0.004214339	-0.007540196	0.009000242	-0.008568432	0.006575733	-0.003604391
	K= 28	0.000345841	0.002542305	-0.004558939	0.005434625	-0.005154002	0.003927004	-0.002118390
	K= 35	0.000157532	0.001555152	-0.002722423	0.003195215	-0.002982482	0.002227255	-0.001158888
	K= 42	0.000034043	0.000920649	-0.001552706	0.001806313	-0.001721694	0.001413652	-0.001035070
	K= 49	0.000735654	0.004688185					

NO.	INDEX	HO(K)	HO(K+1)	HO(K+2)	HO(K+3)	HO(K+4)	HO(K+5)	HO(K+6)
535.	K= 0	0.877111435	0.119788945	-0.110780358	0.096694469	-0.078814447	0.058729745	-C.C38160726
	K= 7	0.018774360	-0.002011289	-C.C11054169	0.019803748	-0.024109785	0.024309460	-0.021127164
	K= 14	0.C15556935	-0.008722305	0.001732316	0.004448924	-0.009C98608	0.011799727	-0.012452826
	K= 21	0.011249349	-0.008610301	0.C05C99609	-0.001330456	-0.002127559	0.004821982	-0.C06466027
	K= 28	0.006960899	-0.006385263	0.C04962981	-0.003012135	0.000887674	0.001076168	-0.002612504
	K= 35	0.003552431	-0.003839092	0.003520942	-0.002731144	0.0C1655607	-C.000497419	-C.C00557812
	K= 42	0.001368805	-0.001854589	0.002000504	-0.00185100C	0.001495265	-0.001047282	C.C00623961
	K= 49	-0.000325280	-0.004890617					

APPENDIX D

Design Program

The computer program used to generate the design solutions in this report is one that may be used to design a variety of equiripple nonrecursive digital filters for orders (2N+1) up to 255. Lowpass and bandpass filters may be specified directly, while highpass filters are derivable from lowpass filters, and band-reject filters are derivable from bandpass filters.

The first data card for the program must have the parameters NPROB, IPRINT, IPLOT, and IPUNCH in 415 format. NPROB is the number of filters to be designed on a particular run; and IPRINT, IPLOT, and IPUNCH are indicators for optional printed, plotted, and punched output, respectively. The appropriate indicator must be set to 1 if an option is desired and 0 if it is not.

Each of the remaining data cards must include the parameters NLS, NP, NUS, DELTA1, DELTA2, DELTA3, HNOMLS, and HNOMUS in 3I5, 5F10.0 format. NLS, NP, and NUS are the numbers of ripples in the lower stopband, passband, and upper stopband, respectively, of a bandpass filter with the filter parameter N = NLS+NP+NUS-1. NP must always be odd for a bandpass filter, and NLS must always be 0 for a lowpass filter. DELTA1, DELTA2, and DELTA3 are the tolerance specifications for the three bands of a bandpass filter. For a lowpass filter, DELTA1 may be set to 0. HNOMLS and NHOMUS are the nominal values of the frequency response for the lower and upper stopbands, respectively, of a bandpass filter, and these values must be less than 1. They are assigned the value 0 whenever the corresponding fields on the data cards are left blank.

The printed output for each filter has a heading listing filter specifications. It also lists the number of iterations required for convergence, final extremum frequencies, final extremum locations in terms of $x = \cos 2\pi F$, impulse response samples, band edges, differences between the calculated values of the response at the indicated band edges and the corresponding tolerance bounds, transition bandwidths, and values of the limits of the tolerance bounds with the magnitudes also expressed in dB. The optional printed output includes initial estimates of the extremum frequencies, differences between the calculated extrema of the response and the corresponding tolerance bounds for each iteration, and the sums of the squares of these differences. An error message is printed and execution ceases for a particular filter if more than N-1 interior extremum frequencies are located or if convergence is not obtained within the alloted 10 + N/10 iterations.

The punched output for each filter is optional and comprises the filter specifications as a heading, the extremum locations in terms of both F and x, the impulse response samples, the band edges, and the transition bandwidths. The plotted output for each filter is also optional and comprises CalComp plots of various segments of the magnitude of the frequency response expressed in decibels. The complete frequency response and an expanded version of the passband are always plotted under this option. Expanded versions of the stopband are also plotted whenever the nominal stopband values are nonzero.

Joseph Siegel

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C  PROGRAM TO OBTAIN NONRECURSIVE BANDPASS EQUIRIPPLE FILTERS BASED ON
C    THE USE OF THE LAGRANGE INTERPOLATION FORMULA
C  VALID FOR ORDERS UP TO 127
C  LOW-PASS MAXIMAL-RIPPLE EQUIRIPPLE FILTERS OBTAINED WHEN NLS=0
C  NP ODD UNLESS NLS=0
C  HIGH-PASS EQUIRIPPLE FILTERS DERIVABLE FROM LOW-PASS EQUIRIPPLE
C    FILTERS:  HHP(K)=((-1)**K)*HLP(K)      (NUS=/=0)
C  BAND-REJECT EQUIRIPPLE FILTERS DERIVABLE FROM BANDPASS EQUIRIPPLE
C    FILTERS:  HBR(0)=1-HBP(0),HBR(K)=-HBP(K)  FOR OTHER K
C  IMPULSE RESPONSE EVEN:  H(-K)=H(K)
      DIMENSION OM(128),OMP(128),FR(3176),HDB(3176),G(128)
      DIMENSION X(128),A(128),XG(3176),F(128)
      DIMENSION XAX(5),YAX(4),YAXP(6),YAXS(6)
      COMMON X,A,XG,F,TWOPI,N1,K
      DOUBLE PRECISION ARG,X,A,XG
      PI=3.141592654
      TWOPI=2*PI
      DATA XAX/'NORM','ALIZ','ED F','REQU','ENCY'/
      DATA YAX/'MAGN','ITUD','E (D','B)'/
      DATA YAXP/'PASS','BAND',' MAG','NITU','DE (','DB)'/
      DATA YAXS/'STOP','BAND',' MAG','NITU','DE (','DB)'/
      READ (5,31) NPROB,IPRINT,IPLOT,IPUNCH
      IF (IPLOT.EQ.1)  CALL NEWPLT ('M7769','8504','BLUEGRID ','BLACK')
      DO 28 KPROB=1,NPROB
      READ (5,30) NLS,NP,NUS,DELTA1,DELTA2,DELTA3,HNOMLS,HNOMUS
      N1=NLS+NP+NUS
      N=N1-1
      WRITE (6,130)
      WRITE (6,31) N,NLS,NP,NUS,DELTA1,DELTA2,DELTA3
      IF (IPUNCH.EQ.1) WRITE (7,31) N,NLS,NP,NUS,DELTA1,DELTA2,DELTA3
C  INITIALIZE EXTREMA OM(K)
      IF (NLS.EQ.0)  GO TO 2
      DOM=0.5/N
      DO 1 K=1,N1
    1 OM(K)=DOM*(K-1)
      HDOM=DOM/2
```

```
      OM(NLS)=OM(NLS)-HDOM                                              EBPF0037
      OM(NLS+1)=OM(NLS+1)+HDOM                                          EBPF0038
      OM(NLS+NP)=OM(NLS+NP)-HDOM                                        EBPF0039
      OM(NLS+NP+1)=OM(NLS+NP+1)+HDOM                                    EBPF0040
      GO TO 49                                                          EBPF0041
    2 IF (N.LT.30)  DELP=0.5/N                                          EBPF0042
      IF (N.GE.30)  DELP=0.5/(N-1)                                      EBPF0043
      DO 3 K=1,NP                                                       EBPF0044
    3 OM(K)=DELP*(K-1)                                                  EBPF0045
      IF (N.LT.30)  DELS=0.5/(N+ALOG(DELTA2/DELTA3))                    EBPF0046
      IF (N.GE.30)  DELS=0.5/(N-1+ALOG(DELTA2/DELTA3))                  EBPF0047
      DO 4 K=1,NUS                                                      EBPF0048
    4 OM(NP+K)=0.5-DELS*(NUS-K)                                         EBPF0049
      IF (NUS.NE.1)  OM(NP+1)=OM(NP+1)+DELS/2                           EBPF0050
   49 IF (IPRINT.EQ.1)  WRITE (6,32) (K,OM(K),K=1,N1)                   EBPF0051
C  SPECIFY FREQUENCY RESPONSE RIPPLES                                   EBPF0052
      IF (NLS.EQ.0)  GO TO 51                                           EBPF0053
      KSIGN=(-1)**NLS                                                   EBPF0054
      DO 50 K=1,NLS                                                     EBPF0055
      F(K)=HNOMLS+KSIGN*DELTA1                                          EBPF0056
   50 KSIGN=-KSIGN                                                      EBPF0057
   51 KSIGN=(-1)**(NP+1)                                                EBPF0058
      DO 52 K=1,NP                                                      EBPF0059
      F(NLS+K)=1+KSIGN*DELTA2                                           EBPF0060
   52 KSIGN=-KSIGN                                                      EBPF0061
      DO 53 K=1,NUS                                                     EBPF0062
      F(NLS+NP+K)=HNOMUS+KSIGN*DELTA3                                   EBPF0063
   53 KSIGN=-KSIGN                                                      EBPF0064
C  STORE COSINES OF FREQUENCIES IN FIXED SEARCH GRID                    EBPF0065
      IF (N.GE.25)  KDIV=25                                             EBPF0066
      IF (N.LT.25)  KDIV=50-N                                           EBPF0067
      NDIV=KDIV*N                                                       EBPF0068
      DOM=0.5/NDIV                                                      EBPF0069
      NPT=NDIV+1                                                        EBPF0070
      DO 54 K=1,NPT                                                     EBPF0071
      FR(K)=DOM*(K-1)                                                   EBPF0072
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```
      ARG=TWOPI*FR(K)                                              EBPF0073
   54 XG(K)=DCOS(ARG)                                              EBPF0074
      NITER=0                                                      EBPF0075
      MXITER=10+N/10                                               EBPF0076
C  PREPARE TO EVALUATE LAGRANGE INTERPOLATION FORMULA              EBPF0077
    5 NITER=NITER+1                                                EBPF0078
      IF (NITER.GT.MXITER)   GO TO 27                              EBPF0079
      DO 6 K=1,N1                                                  EBPF0080
      ARG=TWOPI*OM(K)                                              EBPF0081
    6 X(K)=DCOS(ARG)                                               EBPF0082
      DO 8 I=1,N1                                                  EBPF0083
      A(I)=1                                                       EBPF0084
      DO 7 J=1,N1                                                  EBPF0085
      IF (J.EQ.I)   GO TO 7                                        EBPF0086
      A(I)=A(I)*(X(I)-X(J))                                        EBPF0087
    7 CONTINUE                                                     EBPF0088
    8 A(I)=1/A(I)                                                  EBPF0089
C  FIND ACTUAL INTERIOR EXTREMA OMP(K)                             EBPF0090
      IF (IPRINT.EQ.1)  WRITE (6,34) NITER                         EBPF0091
      K=1                                                          EBPF0092
      HL=F(1)                                                      EBPF0093
      HDB(1)=HL                                                    EBPF0094
      DIFF=0                                                       EBPF0095
      SSOD=0                                                       EBPF0096
      IF (IPRINT.EQ.1)  WRITE (6,35) K,OM(K),F(K),HL,DIFF          EBPF0097
      K=2                                                          EBPF0098
      HM=HOM(2)                                                    EBPF0099
      HDB(2)=HM                                                    EBPF0100
      DHL=HM-HL                                                    EBPF0101
      KPT=3                                                        EBPF0102
  108 HU=HOM(KPT)                                                  EBPF0103
      HDB(KPT)=HU                                                  EBPF0104
      DHU=HU-HM                                                    EBPF0105
      IF (DHL*DHU)  9,9,10                                         EBPF0106
    9 OMP(K)=FR(KPT-1)                                             EBPF0107
      HK=HM                                                        EBPF0108
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      DIFF=ABS(F(K)-HK)                                                 EBPF0109
      SSQD=SSQD+DIFF*DIFF                                               EBPF0110
      IF (IPRINT.EQ.1)  WRITE (6,35) K,CMP(K),F(K),HK,DIFF              EBPF0111
      K=K+1                                                             EBPF0112
      IF (K.GT.N1)  GO TO 26                                            EBPF0113
      HL=HU                                                             EBPF0114
      KPT=KPT+1                                                         EBPF0115
      HM=HOM(KPT)                                                       EBPF0116
      HDB(KPT)=HM                                                       EBPF0117
      DHL=HM-HL                                                         EBPF0118
      GO TO 11                                                          EBPF0119
   10 HM=HU                                                             EBPF0120
      DHL=DHU                                                           EBPF0121
   11 KPT=KPT+1                                                         EBPF0122
      IF (KPT.LE.NPT)  GO TO 108                                        EBPF0123
      K=N1                                                              EBPF0124
      HK=F(N1)                                                          EBPF0125
      DIFF=0                                                            EBPF0126
      IF (IPRINT.EQ.1)  WRITE (6,35) K,CM(K),F(K),HK,DIFF               EBPF0127
      IF (IPRINT.EQ.1)  WRITE (6,36) SSQD                               EBPF0128
C.  CHECK FOR CONVERGENCE                                                EBPF0129
      IF (SSQD.EQ.0.)  GO TO 13                                         EBPF0130
      DO 12 K=2,N                                                       EBPF0131
   12 OM(K)=OMP(K)                                                      EBPF0132
      GO TO 5                                                           EBPF0133
   13 IF (IPRINT.NE.1)  WRITE (6,136) NITER                             EBPF0134
C   COMPUTE IMPULSE RESPONSE SAMPLES H(K)                               EBPF0135
      CALL DFTINV (G)                                                   EBPF0136
      WRITE (6,37) (K,OM(K),F(K),X(K),G(K),K=1,N1)                      EBPF0137
      IF (IPUNCH.NE.1)  GO TO 16                                        EBPF0138
      DO 15 K=1,N1                                                      EBPF0139
   15 WRITE (7,45) X(K),OM(K),G(K)                                      EBPF0140
   16 CONTINUE                                                          EBPF0141
C   FIND BAND EDGES                                                     EBPF0142
      K=1                                                               EBPF0143
      IF (NLS.EQ.0)  GO TO 64                                           EBPF0144
```

```
      DTB=(OM(NLS+1)-OM(NLS))/100                                       EBPF0145
      HLS=HNOMLS+DELTA1                                                 EBPF0146
      OML=OM(NLS)+DTB                                                   EBPF0147
      HL=H(OML)                                                         EBPF0148
   60 OMU=OML+DTB                                                       EBPF0149
      HU=H(OMU)                                                         EBPF0150
      IF (HU.GT.HLS)   GO TO 61                                         EBPF0151
      OML=OMU                                                           EBPF0152
      HL=HU                                                             EBPF0153
      GO TO 60                                                          EBPF0154
   61 OMLS=OML+DTB*((HLS-HL)/(HU-HL))                                   EBPF0155
      HP=1-DELTA2                                                       EBPF0156
      OMU=OM(NLS+1)-DTB                                                 EBPF0157
      HU=H(OMU)                                                         EBPF0158
   62 OML=OMU-DTB                                                       EBPF0159
      HL=H(OML)                                                         EBPF0160
      IF (HL.LT.HP)   GO TO 63                                          EBPF0161
      OMU=OML                                                           EBPF0162
      HU=HL                                                             EBPF0163
      GO TO 62                                                          EBPF0164
   63 OMLP=OML+DTB*((HP-HL)/(HU-HL))                                    EBPF0165
   64 DTB=(OM(NLS+NP+1)-OM(NLS+NP))/100                                 EBPF0166
      HP=1-DELTA2                                                       EBPF0167
      OML=OM(NLS+NP)+DTB                                                EBPF0168
      HL=H(OML)                                                         EBPF0169
   65 OMU=OML+DTB                                                       EBPF0170
      HU=H(OMU)                                                         EBPF0171
      IF (HU.LT.HP)   GO TO 66                                          EBPF0172
      OML=OMU                                                           EBPF0173
      HL=HU                                                             EBPF0174
      GO TO 65                                                          EBPF0175
   66 OMUP=OML+DTB*((HL-HP)/(HL-HU))                                    EBPF0176
      HUS=HNOMUS+DELTA3                                                 EBPF0177
      OMU=OM(NLS+NP+1)-DTB                                              EBPF0178
      HU=H(OMU)                                                         EBPF0179
   67 OML=OMU-DTB                                                       EBPF0180
```

```
      HL=H(OML)                                                         EBPF0181
      IF (HL.GT.HUS)  GO TO 68                                          EBPF0182
      OMU=OML                                                           EBPF0183
      HU=HL                                                             EBPF0184
      GO TO 67                                                          EBPF0185
   68 OMUS=OML+DTB*((HL-HUS)/(HL-HU))                                   EBPF0186
      WRITE (6,39)                                                      EBPF0187
      IF (NLS.EQ.0)  GO TO 69                                           EBPF0188
      HB=H(OMLS)                                                        EBPF0189
      DIFF=ABS(HB-HLS)                                                  EBPF0190
      WRITE (6,40) OMLS,HLS,HB,DIFF                                     EBPF0191
      HB=H(OMLP)                                                        EBPF0192
      DIFF=ABS(HB-HP)                                                   EBPF0193
      WRITE (6,40) OMLP,HP,HB,DIFF                                      EBPF0194
      BWL=OMLP-OMLS                                                     EBPF0195
      WRITE (6,41) BWL                                                  EBPF0196
      IF (IPUNCH.EQ.1)  WRITE (7,40) OMLS,OMLP,BWL                      EBPF0197
   69 HB=H(OMUP)                                                        EBPF0198
      DIFF=ABS(HB-HP)                                                   EBPF0199
      WRITE (6,40) OMUP,HP,HB,DIFF                                      EBPF0200
      HB=H(OMUS)                                                        EBPF0201
      DIFF=ABS(HB-HUS)                                                  EBPF0202
      WRITE (6,40) OMUS,HUS,HB,DIFF                                     EBPF0203
      BWU=OMUS-OMUP                                                     EBPF0204
      WRITE (6,42) BWU                                                  EBPF0205
      IF (IPUNCH.EQ.1)  WRITE (7,40) OMUP,OMUS,BWU                      EBPF0206
      WRITE (6,43)                                                      EBPF0207
      IF (NLS.EQ.0)  GO TO 17                                           EBPF0208
      HU=HNOMLS+DELTA1                                                  EBPF0209
      HUDB=20*ALOG10(ABS(HU))                                           EBPF0210
      HL=HNOMLS-DELTA1                                                  EBPF0211
      HLDB=20*ALOG10(ABS(HL))                                           EBPF0212
      WRITE (6,44) HNOMLS,HU,HUDB,HL,HLDB                               EBPF0213
   17 HNOMP=1                                                           EBPF0214
      HU=HNOMP+DELTA2                                                   EBPF0215
      HUDB=20*ALOG10(ABS(HU))                                           EBPF0216
```

```
      HL=HNOMP-DELTA2                                                   EBPF0217
      HLDB=20*ALOG10(ABS(HL))                                           EBPF0218
      WRITE (6,44) HNOMP,HU,HUDB,HL,HLDB                                EBPF0219
      HU=HNOMUS+DELTA3                                                  EBPF0220
      HUDB=20*ALOG10(ABS(HU))                                           EBPF0221
      HL=HNOMUS-DELTA3                                                  EBPF0222
      HLDB=20*ALOG10(ABS(HL))                                           EBPF0223
      WRITE (6,44) HNOMUS,HU,HUDB,HL,HLDB                               EBPF0224
C   PLOT MAGNITUDE CURVES                                               EBPF0225
      IF (IPLOT.NE.1)  GO TO 28                                         EBPF0226
      DO 18 I=1,NPT                                                     EBPF0227
   18 HDB(I)=20*ALOG10(ABS(HDB(I)))                                     EBPF0228
      CALL PICTUR (20.,8.,XAX,20,YAX,14,FR,HDB,NPT,0.,KS)               EBPF0229
      IF (NLS.NE.0)  GO TO 19                                           EBPF0230
      LP=40*OMUP                                                        EBPF0231
      XIN=LP+1                                                          EBPF0232
      NPTP=OMUP/DOM+3                                                   EBPF0233
      CALL PICTUR (XIN,6.,XAX,20,YAXP,23,FR,HDB,NPTP,0.,KS)             EBPF0234
      GO TO 22                                                          EBPF0235
   19 IF (HNOMLS.EQ.0.)  GO TO 20                                       EBPF0236
      LS=40*OMLS                                                        EBPF0237
      XIN=LS+1                                                          EBPF0238
      NPTS=OMLS/DOM+3                                                   EBPF0239
      CALL PICTUR (XIN,6.,XAX,20,YAXS,23,FR,HDB,NPTS,0.,KS)             EBPF0240
   20 LP=40*(OMUP-OMLP)                                                 EBPF0241
      XIN=LP+1                                                          EBPF0242
      NPTLP=OMLP/DOM-4                                                  EBPF0243
      NPTUP=OMUP/DOM+3                                                  EBPF0244
      NPTP=NPTUP-NPTLP                                                  EBPF0245
      DO 21 I=1,NPTP                                                    EBPF0246
      K=NPTLP+I                                                         EBPF0247
      FR(I)=FR(K)                                                       EBPF0248
   21 HDB(I)=HDB(K)                                                     EBPF0249
      CALL PICTUR (XIN,6.,XAX,20,YAXP,23,FR,HDB,NPTP,0.,KS)             EBPF0250
   22 IF (HNOMUS.EQ.0.)  GO TO 28                                       EBPF0251
      LS=40*(0.5-OMUS)                                                  EBPF0252
```

```
      XIN=LS+1                                                          EBPF0253
      NPTUS=OMUS/DOM-4                                                  EBPF0254
      NPTS=NPT-NPTUS                                                    EBPF0255
      DO 23 I=1,NPTS                                                    EBPF0256
      K=NPTUS+I                                                         EBPF0257
      FR(I)=FR(K)                                                       EBPF0258
   23 HDB(I)=HDB(K)                                                     EBPF0259
      CALL PICTUR (XIN,6.,XAX,20,YAXS,23,FR,HDB,NPTS,0.,KS)             EBPF0260
      GO TO 28                                                          EBPF0261
   26 WRITE (6,33)                                                      EBPF0262
      GO TO 28                                                          EBPF0263
   27 WRITE (6,38)                                                      EBPF0264
   28 CONTINUE                                                          EBPF0265
      IF (IPLOT.EQ.1)  CALL ENDPLT                                      EBPF0266
   30 FORMAT (3I5,5F10.0)                                              EBPF0267
  130 FORMAT ('1   N  NLS   NP  NUS    DELTA1     DELTA2     DELTA3')   EBPF0268
   31 FORMAT (4I5,F10.5,F10.4,F10.5)                                    EBPF0269
   32 FORMAT ('0INDEX    INITIAL OM(K)'/(I6,F16.6))                     EBPF0270
   33 FORMAT ('0TERMINATION BECAUSE MORE THAN N-1 INTERIOR EXTREMA ',   EBPF0271
     1'FOUND')                                                          EBPF0272
   34 FORMAT ('0INDEX        OM(K)   HB(OM(K))       H(OM(K))    ',     EBPF0273
     1'|DIFFERENCE|',12X,'ITERATION',I3)                                EBPF0274
   35 FORMAT (I6,2F12.6,2F14.8)                                         EBPF0275
   36 FORMAT ('0SUM OF SQUARED DIFFERENCES=',E15.8)                     EBPF0276
  136 FORMAT ('0NUMBER OF ITERATIONS=',I3)                              EBPF0277
   37 FORMAT ('0INDEX        OM(K)          F(K)           X(K)    ',   EBPF0278
     1'IMP RSP H(K)'/(I6,2F12.6,F14.8,F15.9))                           EBPF0279
   38 FORMAT ('0TERMINATION BECAUSE CONVERGENCE TO REQUIRED ACCURACY NOT EBPF0280
     1 OBTAINED IN ALLOTTED NUMBER OF ITERATIONS')                      EBPF0281
   39 FORMAT ('0  BAND EDGE      HB(OMB)          H(OMB)    |DIFFERENCE|') EBPF0282
   40 FORMAT (2F12.6,2F14.8)                                            EBPF0283
   41 FORMAT ('0STOPBAND-PASSBAND TRANSITION BANDWIDTH=',F9.6)          EBPF0284
   42 FORMAT ('0PASSBAND-STOPBAND TRANSITION BANDWIDTH=',F9.6)          EBPF0285
   43 FORMAT ('0    NOMINAL H    HNOM+DELTA    |H+D| (DB)    HNOM-DELTA    ', EBPF0286
     1'|H-D|  (DB)')                                                    EBPF0287
   44 FORMAT (5F13.6)                                                   EBPF0288
```

```
45 FORMAT (F25.16,F15.8,F15.9)                                           EBPF0289
   CALL EXIT                                                             EBPF0290
   END                                                                   EBPF0291
                                                                         EBPF0292
C  PROGRAM TO EVALUATE FREQUENCY RESPONSE AT POINTS IN FIXED SEARCH GRID EBPF0293
   FUNCTION HOM (KPT)                                                    EBPF0294
   DIMENSION X(128),A(128),XG(3176),F(128)                               EBPF0295
   COMMON X,A,XG,F,TWOPI,N1,K                                            EBPF0296
   DOUBLE PRECISION X,A,XG,SUMN,SUMD,AXJ                                 EBPF0297
   IF (K.EQ.1)  GO TO 2                                                  EBPF0298
   IF (XG(KPT).NE.X(K-1))  GO TO 1                                       EBPF0299
   HOM=F(K-1)                                                            EBPF0300
   RETURN                                                                EBPF0301
 1 IF (XG(KPT).NE.X(K))  GO TO 2                                         EBPF0302
   HOM=F(K)                                                              EBPF0303
   RETURN                                                                EBPF0304
 2 SUMN=0                                                                EBPF0305
   SUMD=0                                                                EBPF0306
   DO 3 J=1,N1                                                           EBPF0307
   AXJ=A(J)/(XG(KPT)-X(J))                                               EBPF0308
   SUMN=SUMN+AXJ*F(J)                                                    EBPF0309
 3 SUMD=SUMD+AXJ                                                         EBPF0310
   HOM=SUMN/SUMD                                                         EBPF0311
   RETURN                                                                EBPF0312
   END                                                                   EBPF0313
                                                                         EBPF0314
C  PROGRAM TO EVALUATE FREQUENCY RESPONSE AT POINTS IN BAND-EDGE SEARCH  EBPF0315
   FUNCTION H (OM)                                                       EBPF0316
   DIMENSION X(128),A(128),XG(3176),F(128)                               EBPF0317
   COMMON X,A,XG,F,TWOPI,N1,K                                            EBPF0318
   DOUBLE PRECISION X,A,XG,ARG                                           EBPF0319
   ARG=TWOPI*OM                                                          EBPF0320
   XG(K)=DCOS(ARG)                                                       EBPF0321
   H=HOM(K)                                                              EBPF0322
   RETURN                                                                EBPF0323
   END                                                                   EBPF0324
```

```
                                                                    EBPF0325
C   PROGRAM TO COMPUTE IMPULSE RESPONSE SAMPLES H(K)                EBPF0326
      SUBROUTINE DFTINV (G)                                         EBPF0327
      DIMENSION G(128),HK(128)                                      EBPF0328
      DIMENSION X(128),A(128),XG(3176),F(128)                       EBPF0329
      COMMON X,A,XG,F,TWOPI,N1,K                                    EBPF0330
      DOUBLE PRECISION ARG,SUM,X,A,XG                               EBPF0331
      N=N1-1                                                        EBPF0332
      CN=2*N+1                                                      EBPF0333
      HK(1)=F(1)                                                    EBPF0334
      DO 1 K=2,N1                                                   EBPF0335
      ARG=TWOPI*(K-1)/CN                                            EBPF0336
      XG(K)=DCOS(ARG)                                               EBPF0337
    1 HK(K)=HOM(K)                                                  EBPF0338
      C=TWOPI/CN                                                    EBPF0339
      DO 3 L=1,N1                                                   EBPF0340
      SUM=0                                                         EBPF0341
      ARG=C*(L-1)                                                   EBPF0342
      DO 2 K=1,N                                                    EBPF0343
    2 SUM=SUM+HK(K+1)*DCOS(ARG*K)                                   EBPF0344
      SUM=2*SUM+HK(1)                                               EBPF0345
    3 G(L)=SUM/CN                                                   EBPF0346
      RETURN                                                        EBPF0347
      END                                                           EBPF0348
```

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A design procedure for the class of nonrecursive digital filters exhibiting equiripple passband and stopband characteristics is presented. With this method it is possible for a designer to obtain the coefficients necessary to realize a desired filter without having to implement the design algorithm on a general-purpose digital computer. This method also enables the designer to examine several alternative designs before deciding on a particular solution. In particular, using a recently proposed algorithm, we have generated designs for more than 500 filters and systematically catalogued them in both tabular and graphical form. Design curves relating the various filter parameters are presented, as well as relations for estimating the required filter specifications and for interpolation on the curves between tabulated designs. Transformations are included to cover highpass filter design and to enable the design of other sets of filters not explicitly catalogued. Sections are included to demonstrate the use of the design curves and tables and to discuss nonlinear phase filters. An appendix by Joseph Siegel gives the computer program used to generate the design solutions.

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